DRAFT ENVIRONMENTAL IMPACT STATEMENT

for the

Proposed M-Pit Mine Expansion At the Montana Tunnels Mine In Jefferson County, Montana

January 2008

State of Montana
Department of Environmental Quality

United States Department of the Interior
Bureau of Land Management
Butte Field Office

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Executive Summary

Introduction

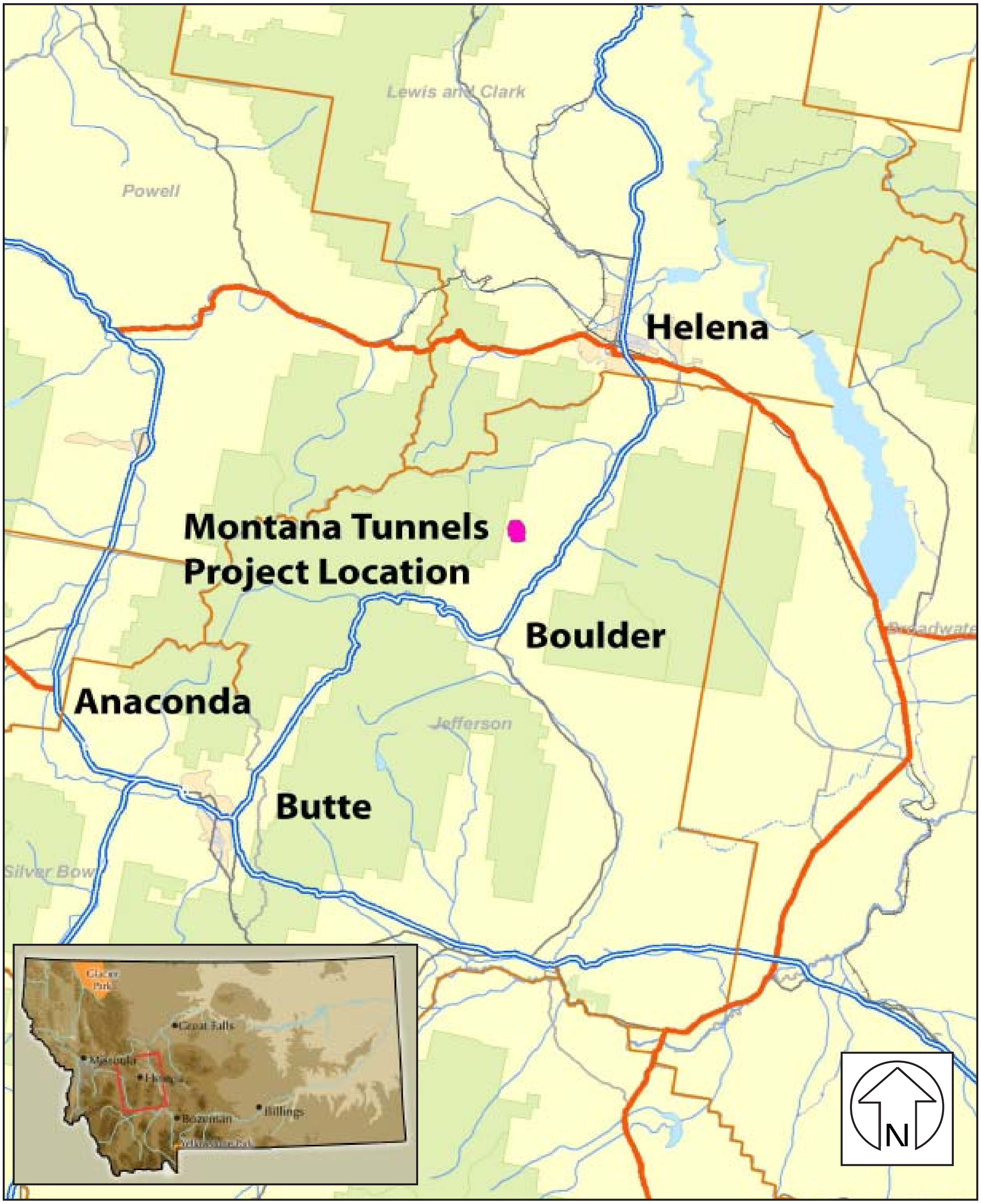
This draft environmental impact statement (EIS) has been prepared for the proposed M-Pit Mine Expansion at the Montana Tunnels Mining, Inc. (Montana Tunnels) Mine in Jefferson County, Montana (**Figure ES-1)**. The Montana Department of Environmental Quality (DEQ) and the U.S. Bureau of Land Management (BLM) are co-lead agencies preparing the impact analysis. The U.S. Army Corps of Engineers (Corps of Engineers) is a cooperating agency on this EIS. The EIS for the M-Pit Mine Expansion at the Montana Tunnels Mine presents the analysis of possible environmental consequences of three alternatives: Alternative 1 - No Action Alternative (L-Pit), which is Montana Tunnels' present Operating Permit 00113 for the L-Pit Plan; Alternative 2 - Proposed Action Alternative (M-Pit), which is the Montana Tunnels Proposed Action for the M-Pit Mine Expansion; and Alternative 3 - Agency Modified Alternative, which is the agency-modified alternative including mitigations. The three alternatives are described in Chapter 2 of this EIS.

The Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA) and their implementing rules and regulations require that if actions taken by the State of Montana and BLM may significantly affect the quality of the human environment, then an EIS must be prepared. This EIS was written to fulfill the requirements of these laws. The DEQ Director and the BLM Field Manager will use the EIS to decide which alternative should be approved.

Purpose and Need

Montana Tunnels currently mines ore containing gold, zinc, lead, and silver from an open pit (mine pit) under Operating Permit 00113, issued by the State of Montana under the Montana Metal Mine Reclamation Act ([MMRA]; 82-4-301 *et seq.*, Montana Code Annotated [MCA]), and under Plan of Operations No. MTM 82856, issued by BLM, referred to as "Operating Permit" throughout this EIS. Montana Tunnels wants to expand the existing mine pit to access and mine additional ore resources.

Montana Tunnels has applied to DEQ and BLM for an amendment to its operating and reclamation plans. Proposed adjustments to the present Operating Permit include increasing the permitted area and depth of the mine pit, expanding waste rock disposal areas, raising the tailings storage facility embankment, realigning a portion of the Jefferson County mine access road, diverting the course of two stream channels, and creating new soil stockpiles. Montana Tunnels proposes to extend operations by about 5 years beyond the current operating plan. An estimated 24 to 28 million additional tons of ore would be removed. The reclamation plan changes include routing additional stormwater to the mine pit to aid flooding of a post-mining pit lake.



SCALE: 1" = 15 miles (approx.)

Interstate
Secondary Road
Secondary Access Road
County Line

FIGURE ES-1
Project Location Map

Montana Tunnels Project

In addition, Clancy Creek would be diverted around the expanded pit during operations. After mining is complete, a portion of the flow in Clancy Creek adjacent to the mine pit would be continually diverted into the pit. The post-mining pit lake would reach equilibrium about two centuries after mining ceases at elevation 5,625 feet, or about 25 feet below the elevation of Clancy Creek (5,650 feet).

Montana Tunnels also proposes to donate several buildings including the mill, warehouse and office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation for post-mining economic development. These changes constitute a major amendment to Montana Tunnels' operating and reclamation plans.

Project Area

The Montana Tunnels Mine is located in Jefferson County, Montana, approximately 25 miles south of the city of Helena. A map showing the project location and study area is presented in **Figure ES-1**.

Issues Identified During Scoping

Issues of Concern

The primary issues of concern raised during scoping for the Montana Tunnels M-Pit Mine Expansion pertained to six general subject areas: hydrology, wetlands and Waters of the U.S., fisheries and aquatics, wildlife, engineering, and socioeconomics. The issues are summarized below.

Hydrology

- Potential impacts to surface water and groundwater quality and quantity in the Clancy Creek, Pen Yan Creek, and Spring Creek drainages
- Potential impacts to existing water rights
- Geochemistry and water quality of the post-mining pit lake and stormwater
- The potential need for a Montana Pollutant Discharge Elimination System (MPDES) permits
- The potential need for a water treatment plant

Wetlands and Waters of the U.S.

- Potential impacts to wetlands and Waters of the U.S., in particular Clancy Creek wetlands and streambed
- Loss of the creek streambed and the diversion of Clancy Creek water into the pit, away from the existing wetlands
- Water quality and the downstream wetlands after the pit lake reaches equilibrium

Fisheries and Aquatics

- Potential impacts to fisheries and aquatic insects in Clancy Creek
- The viability of the fish population upstream of the proposed Clancy Creek diversion
- The potential impact of the pit lake after mining on fish and aquatic populations

Wildlife

- The potential impacts to wildlife populations, including game animals, sensitive species, threatened and endangered species, and biodiversity
- The cumulative potential impacts from other human activity in the area
- The potential impacts to wildlife movement corridors

Engineering

- The potential impacts to pit highwall stability from allowing the M-Pit Mine Expansion
- Potential impacts to the Clancy Creek channel
- The stability of the pit highwalls and the tailings storage facility in the case of an earthquake

Socioeconomics

- The potential impacts to the Jefferson County tax base, wages and benefits for the area, and schools from not permitting the mine expansion.

Cultural Resources

- One site has been determined “eligible” for listing on the National Register of Historic Places within the mine expansion permit boundary.

Description of Alternatives

Alternative 1 - No Action Alternative (L-Pit)

Alternative 1 is the Montana Tunnels L-Pit Plan as it is permitted (**Figure ES-2**). Montana Tunnels was permitted to mine an average of 15,000 tons per day. The mining method has not changed since the mine was approved in 1986. The mine currently produces 11,000 to 20,000 tons of ore per day. Drilling, blasting, loading, and hauling take place on 20-foot benches as the mine pit is deepened. Projected average annual ore production is 4 to 6 million tons depending on conditions through the remaining approved L-Pit Plan.

Mine Pit

The approved footprint of the mine pit is 248.4 acres. The mine pit is permitted to extend from the 6,430-foot elevation to the 4,250-foot elevation at the pit bottom. The pit rim daylight elevation at the lowest point would be 5,670 feet on the southeast side of the pit. The mine is accessed by a primary haul ramp on the southeast side of the mine pit.

Tailings Storage Facility

The tailings storage facility embankment has been incrementally permitted to the current elevation of 5,660 feet. The tailings storage facility embankment (tailings embankment) crest elevation at 5,660 feet is sufficient to contain all tailings volume and maintain contingency freeboard under Alternative 1. Structural performance of the tailings embankment would be monitored after mining and ore processing have been completed. Stability monitoring would involve a continuation of piezometer readings within the embankment, monitoring of flows from the embankment combined drain system, and monitoring of tailings settlement during the closure and post-closure periods.

Waste Rock Storage Areas

Montana Tunnels projects that approximately 122.3 million cubic yards of waste rock would eventually be placed in the 425.9 acres of waste rock storage areas. Montana Tunnels stores waste rock in several different waste rock storage areas. The primary waste rock storage area is adjacent to the west side of the tailings storage facility. A waste rock buttress downstream of the tailings embankment improves the stability of the tailings storage facility. A 42-acre waste rock storage contingency area on the south

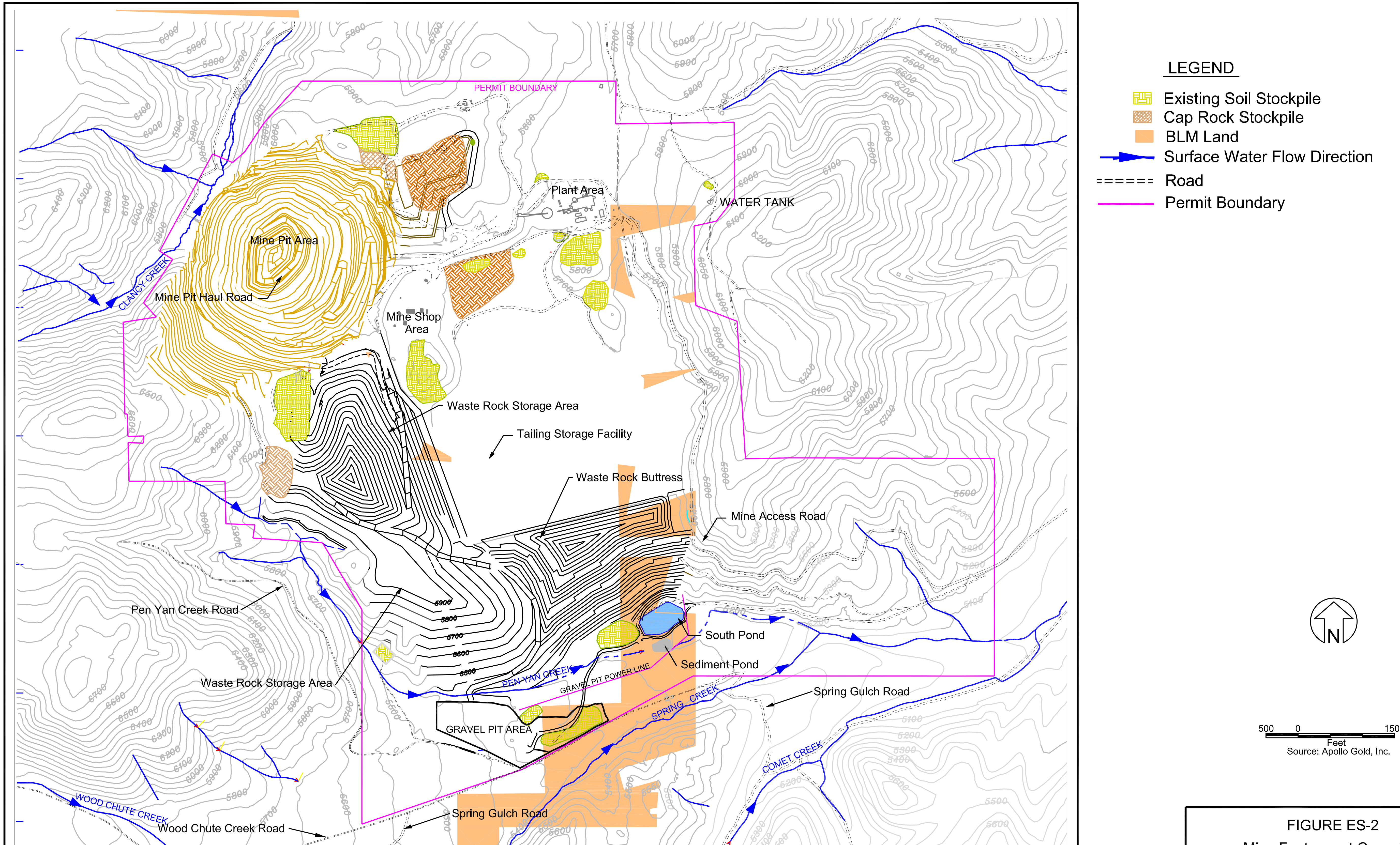


FIGURE ES-2

Mine Features at Cessation of Mining

Montana Tunnels Project

side of Pen Yan Creek that would require diversion of Pen Yan Creek is permitted but not bonded and not included in disturbance acreage totals listed above for Alternative 1.

Pen Yan Creek Diversion

The Pen Yan Creek drainage is permitted to be realigned to expand the waste rock storage area, but Montana Tunnels is not planning to do so under the approved L-Pit plan of operations. Montana Tunnels has been able to contain the waste rock from the L-Pit Mine Plan in waste rock storage areas without developing the waste rock storage area south of Pen Yan Creek.

Clancy Creek Diversion

The Clancy Creek channel would not be disturbed and the current flow regime in Clancy Creek would not be altered. After mining ceases, flows from Clancy Creek would not be used to fill the L-Pit to accelerate pit lake filling.

Reclamation

The objectives of reclamation are to stabilize disturbed areas as soon as practical during the operational phase. The final reclamation objective is to complete reclamation of all disturbed areas and return the land to useful productivity. A 5-year closure period is planned to reclaim all areas disturbed by mining activities. A period after closure is also planned for monitoring and maintenance. Approximately 30 percent of areas disturbed by mining would have been reclaimed by concurrent reclamation prior to closure.

Reclamation of all remaining facilities would commence at the conclusion of mining operations. Closure of the tailings storage facility surface would require a 5-year period to allow time for sufficient dewatering and settlement of tailings solids. When the milling process ends, dewatering of the tailings storage facility would begin. The ponded water on the tailings storage facility surface would be removed during the first years following cessation of mining and would be pumped to the mine pit. The final surface of the tailings storage facility would have a 0.5 to 5 percent slope to the east in lined drainages toward a spillway. Surface runoff after the 5-year closure period would report to a percolation pond constructed in the former south pond.

The tailings surface would be capped with 36 inches of nonacid-generating rock and covered with an additional 24 inches of soil which would then be seeded to minimize water infiltration and to complete final reclamation. More soil would need to be placed if additional settlement occurred after soil placement. After soil application, the tailings

surface area would be amended with fertilizer and plowed to loosen the soil. The tailings surface would then be drill seeded with a grasslands seed mixture. Run-on control ditches upgradient of the tailings storage facility surface would divert water away from the facility.

The waste rock storage areas are reclaimed incrementally as lifts are completed. Any reclamation of waste rock storage areas that cannot be completed concurrently with mining would be completed after closure. Steep slopes between benches would be regraded to 2.5h:1v. Three feet of cap rock would be spread over dump tops or dump slopes if chemical testing indicates that the surface materials have acid generating potential. The cap rock would not be added to slopes that did not exhibit acid generating potential. Drainage benches would be established to route stormwater runoff from the reclaimed surface. Sixteen inches of soil would be spread on all surfaces, regardless of whether the cap rock had been added or not. The dump surfaces would then be revegetated to minimize infiltration.

Final reclamation of the facilities area would occur at the conclusion of operations. The facility area would be contoured, and buildings would be removed.

At closure, most of the mine pit dewatering system would be shut off, and the pit would begin to fill with water. Because of stability problems in the northwest highwall of the pit, vertical pumping wells would be maintained on the north, northwest, and southwest highwalls for 5 years during closure to provide a factor of safety of at least 1.2 during the early stages of mine pit flooding. The pit would remain accessible above the water level by way of the pit access ramp. Montana Tunnels' plan would allow the pit highwalls to naturally weather and ravel into the pit, cover pit benches, and form talus slopes above the pit lake. The pit lake would take almost two centuries to fill. It would equilibrate about 60 feet below the lowest pit rim elevation (5,670 feet) and not have a surface water discharge. About 7 gallons per minute would seep from the pit and report to the Spring Creek drainage as groundwater when the pit lake is full.

Cap Rock

Cap rock is non-sulfide mostly volcanic waste rock generally obtained from the overburden in the upper highwalls of the mine. Cap rock is stored in stockpiles to be used as reclamation cover materials. There are currently over 5 million cubic yards of excess cap rock stockpiled at the mine. If cap rock stockpiles are not completely used, the stockpiles would be graded during reclamation to match existing topography. The area would be covered with soil and reseeded in a manner consistent with the mine's reclamation plan for waste rock storage areas.

South Pond

The south pond would be used to collect tailings storage facility seepage water and recovery well system discharge during the 5-year closure period. The water in the south pond would be pumped to the pit to accelerate pit filling. After the 5-year closure period, the south pond would be converted to a percolation pond to manage the remaining seepage water and surface water runoff from the reclaimed tailings storage facility.

Roads

The main access road is 2.6 miles long from the Wickes county road to the mine site, running west and then north around the side of Alta Mountain. The access road will remain at closure. The road presently meets county road specifications. The 1986 final EIS and the Operating Permit discuss the potential for the Spring Gulch Road to be covered with waste rock. Although permitted, this aspect of the operating permit was not implemented, and Montana Tunnels does not now intend to cover the road as part of the L-Pit Mine Plan. Relocation and/or reconstruction would not be required.

The service road to the waste rock storage area would be reclaimed as a drainage channel as part of the waste rock storage area drainage system. The upper south pit ramp would be reclaimed by pulling back the bank or using fill as necessary to bring this area back to natural slope. Roads would be ripped before soil and seed are applied. The pit access ramp would be reclaimed from the pit rim to the modeled high water mark of the pit lake at closure.

Water Monitoring

During the 5-year closure period, up to 14 compliance wells and several surface water sites would be sampled quarterly. Additional water samples would be taken from the flooding mine pit. Sample results from closure period monitor locations would be evaluated and, based on findings and approval from DEQ and BLM, the monitoring frequencies and lists of measured parameters could be reduced over time. Sampling in the flooding pit lake would continue at different depths during the period after closure.

The water quality monitoring program would not be static or inflexible. The program would remain flexible enough to respond to data trends, changes in informational requirements and site specific situations.

Alternative 2 - Proposed Action Alternative (M-Pit)

Development drilling programs at Montana Tunnels have delineated additional ore that provides a large reserve for mining and milling beyond the approved L-Pit plan of operations. Montana Tunnels proposes to extend its life-of-mine plan to access the M-Pit ore reserve by open pit mining methods as described in the application for amendment to Operating Permit 00113. The added ore reserve would lengthen mining and milling operational life by about 5 years. The overall life of mine would be 27 years.

Proposed changes to the current Operating Permit include (1) increasing the permitted area and depth of the open pit mine; (2) expanding waste rock storage areas; (3) raising the tailings storage facility embankment to hold additional tailings; (4) providing staging areas for soil and gravel; (5) diverting the courses of two stream channels; (6) rerouting a portion of the mine access road around the tailings storage facility; and (7) routing surface flows from Clancy Creek into the mine pit.

Mine Pit

The mine pit would increase in area by 39.3 acres from 248.4 acres (Alternative 1) to 287.7 acres (Alternative 2). The pit floor elevation would deepen 200 feet, from 4,250 feet to 4,050 feet. In addition to the flows used to accelerate pit filling as described in Alternative 1, Montana Tunnels would use part of its water rights on Clancy Creek and divert a portion of Clancy Creek flow to the pit.

Tailings Storage Facility

The tailings storage facility surface area would increase from 259.3 acres in Alternative 1 to 272.6 acres in Alternative 2 and would contain up to about 130 million tons of tailings. The tailings elevation would rise approximately 50 feet. The surface elevation and plan area of the tailings storage facility would increase to contain the additional 24 to 30 million tons of tailings. The final surface gradient of the facility for Alternative 2 would route stormwater runoff flows to the mine pit rather than to the spillway and south pond.

Waste Rock Storage Areas

Under Alternative 2, approximately 46.3 million cubic yards of waste rock would be removed from the expanded mine pit over a 5-year mining period and placed in the 579.1 acres of waste rock storage areas. Waste rock storage for Alternative 2 would begin by raising the main waste rock storage area west of the tailings storage facility before extending the waste rock storage area southward across an ephemeral section of

Pen Yan Creek. The expanded waste rock storage area would be constructed and reclaimed using the same design and methods as Alternative 1, but with higher dump lifts proposed. For more efficient mining production, the waste rock storage area would be built using 150-foot-thick lifts(layers) (Alternative 2) compared to the 50-foot-thick lifts under Alternative 1.

Pen Yan Creek Diversion

The larger waste rock storage area would cross the present channel of Pen Yan Creek channel and cover a 3,950-foot-long ephemeral section of Pen Yan Creek. This contingency storage area was permitted and never used by Montana Tunnels. A portion of the Pen Yan Creek drainage would be realigned around the base of the proposed waste rock storage area footprint. Pen Yan Creek is ephemeral and most flow infiltrates to underlying alluvium and colluvium. The realigned Pen Yan Creek drainage would be designed to mimic the existing drainage and route stormwater to the existing sedimentation pond. Sedimentation pond flow would continue to be diverted into south pond through a pipe.

Clancy Creek Diversion

For Alternative 2, the expansion on the northwest side of the mine pit would remove the channel, underlying alluvium, and associated wetlands of approximately 1,800 feet of the Clancy Creek drainage. During mining operations, upstream Clancy Creek surface water and groundwater flows would be diverted around the M-Pit using a combination of a pipe and an open-flow channel. The rerouted flow would rejoin the main Clancy Creek channel downstream of the mine pit 2,600 feet from the upstream diversion.

A cutoff wall for groundwater and a head gate would be constructed to divert water into a 2,000-foot-long, 16-inch pipe that would be buried below the ground surface. The headgate would be constructed with a spillway to divert flows greater than the 5-year, 24-hour flow into the mine pit. This water would be managed as process water. The discharge end of the 2,000-foot-long pipe would convey Clancy Creek water to a 600-foot constructed open-flow channel beginning at an ephemeral drainage on the northwest side of the mine. A bedrock cutoff wall would be constructed across the alluvial channel of the ephemeral drainage to bring groundwater into the constructed channel. The open channel portion of the diversion would be lined to prevent water seepage in the area of the mine. The open channel would convey water from the ephemeral drainage and Clancy Creek back to a downstream reconnection point with Clancy Creek.

About 4.77 acres of delineated wetlands would be disturbed as part of Alternative 2. Approximately 2.64 acres of wetlands would be excavated and removed by the expansion of the mine pit rim and the relocated Clancy Creek channel. Montana Tunnels proposes to provide 5.13 acres of new mitigated wetlands in the broad Clancy Creek valley downstream of the relocated Clancy Creek channel to compensate for the disturbance of 4.77 acres. A wetlands mitigation ratio of approximately 1.14 to 1 is proposed for the 2.64 acres of wetlands that would be excavated in the M-Pit Mine Expansion area.

Following closure of the mine, a portion of the flow from Clancy Creek would continue to be diverted around the M-Pit to maintain the downstream wetlands. The remaining flow in Clancy Creek would be diverted into the mine pit to augment formation of a pit lake after mining.

Reclamation

An additional 70.7 acres would be disturbed for soil and gravel stockpiles and contingency areas under Alternative 2. Montana Tunnels projects that at the end of mining a surplus of approximately 400,000 cubic yards of soil would be available for reclamation.

Reclamation objectives, activities and schedule for Alternative 2 would be the same as those described under Alternative 1.

Cap Rock

Similar to Alternative 1, there would be approximately 5 million cubic yards of excess cap rock stockpiled at the mine for Alternative 2. If cap rock stockpiles are not completely used, the stockpiles would be graded, soiled, and seeded consistent with the reclamation plan for other waste rock storage areas.

South Pond

Similar to Alternative 1, the south pond would be used to collect tailings storage facility seepage water and recovery well system discharge during the 5-year closure period. The water in the south pond would be pumped to the pit to accelerate formation of a pit lake after mining. After the 5-year closure period, the south pond would be converted to a percolation pond to manage the remaining seepage water from the reclaimed tailings storage facility. Surface water runoff from the tailings storage facility would not report to the south pond in the M-Pit plan.

Roads

A portion of the main Jefferson County access road would be realigned around the tailings embankment. The newly constructed main access road would remain at closure as part of the Jefferson County road system.

The Spring Gulch road would be relocated a short distance to the south of the current road. Montana Tunnels plans no interruption to access while the replacement section of the road is constructed. The Spring Gulch road would be replaced with 4,000 feet of gravel road parallel to the base of the waste rock storage area. The new road would reconnect with gravel roads crossing Wood Chute Creek and provide access to Blue Bird Ridge by way of the Wood Chute Creek and/or Pen Yan Creek gravel roads.

Water Monitoring

The water monitoring plan and schedule for Alternative 2 would differ from Alternative 1. Six existing monitoring wells (GW-1, GW-3, MW-1, MW-2, MW-3, and MW-4) would be abandoned in the area of new disturbance, and six new monitoring wells (GW-NEW1, GW-NEW2, GW-NEW3, GW-NEW4, GW-CC1 and GW-CC2) would be added to the water monitoring program. Two existing surface water monitoring stations (SW-16 and SW-16A) would be monitored for water quality parameters in addition to flow.

Water monitoring after closure would be conducted in accordance with the Operational Permit Hydrologic Monitoring Schedule during the 5-year closure period. At the end of closure, the data from the quarterly monitoring would be reviewed. If no adverse changes in water quality or physical characteristics are observed, a recommendation would be made to reduce the sampling frequency for all of the monitored sources to one-half of the quarterly monitoring with possible further reductions for background and upgradient monitor wells.

Additional sampling would be proposed for the filling pit lake to obtain surface samples and samples at depth at least one time per year. The frequency of sampling and parameter list could be modified based on sample results, if appropriate.

The operational and water quality monitoring programs after closure would not be static or inflexible. The programs would remain flexible enough to respond to data trends, changes in informational requirements and site specific situations.

Alternative 3 – Agency Modified Alternative

Alternative 3 would be similar to Alternative 2, with the exception that specific project modifications would be incorporated to address the following issues:

- Issue A: Management of tailings storage facility seepage after closure based on the results of water quality monitoring during the 5-year closure period;
- Issue B: Control of wind-blown dust from the tailings surface during closure;
- Issue C: Creation of a natural and more functional dendritic drainage pattern on the waste rock storage area reclaimed surface;
- Issue D: Development of a contingency plan and operational geochemical verification program to handle potentially acid-generating waste rock based on kinetic test results, and on-going monitoring of waste material mined from the M-Pit Mine Expansion zone. Selective handling criteria based on these test results must meet timely material handling requirements in the proposed M-Pit mine plan;
- Issue E: Establishment of a reconstructed Clancy Creek channel soon after commencing the M-Pit Mine Expansion that would convey the 1 in 20 year return period 24 hour storm event. The reconstructed and lined open-flow channel would be located a sufficient distance from the mine pit rim to ensure stability and thus protect streamflow, wetlands and fisheries;
- Issue F: Implementation of operational and geotechnical measures to ensure Clancy Creek flows do not enter to the M-Pit in the future; and
- Issue G: Development of additional mitigations required during operations and reclamation.

Project specific modifications for Alternative 3 are summarized below for the M-Pit, waste rock storage areas, tailings storage facility, and reconstructed Clancy Creek open-flow channel.

Mine Pit

- Montana Tunnels would implement operational M-Pit mining measures to achieve and maintain stability of the highwall and long-term Clancy Creek stability after closure. In part, stability requirements include the use of low-damage blasting practices, aggressive groundwater depressurization, and implementation of a proactive geotechnical monitoring program (Issue F).

- Groundwater depressurization would be required along the northwest pit highwall during operations and after closure. A combination of vertical pumping wells and horizontal drains would be used to remove groundwater. The minimum groundwater depressurization depth would be 100 feet (Issue F).

Tailings Storage Facility

- If water quality from the combined drains does not meet groundwater quality standards by the end of the closure period, Montana Tunnels would maintain the south pond and liner system, continue pumping untreated water into the pit, or treat or otherwise manage water to ensure the discharge meets groundwater quality standards (Issue A).
- If water in the tailings storage facility combined drains meets all groundwater quality standards, Montana Tunnels would bury the south pond at reclamation to avoid any surface water discharge and continue to monitor groundwater quality during the process of tailings consolidation (Issue A).
- Montana Tunnels would limit wind-blown dust from the tailings surface using an irrigation system to maintain a wetted tailings surface or other dust abatement technology, as appropriate, until such time that vegetation has been established or dust production is otherwise controlled (Issue B).
- During reclamation of the tailings storage facility surface, the placement of cap material results in lateral displacement of underlying slimes. It may be necessary to implement a site specific dewatering plan to reduce the fluidity of the slimes to a level where the capping material can be placed without displacement of the slimes. If dewatering of the slimes can not be achieved without delays to the capping plan, (1) an agency approved geotextile layer would be added to the cap design to create a structural bridge over less stable areas of the tailings, or (2) tailings slimes would be pumped into the mine pit. The choice of mitigation would be based on effectiveness of implementation (Issue A).
- Differential settlement of the tailings would occur after the initial cap is installed. In order to maintain the desired drainage pattern of the reclaimed tailings storage facility surface, additional capping material on low areas of the reclaimed surface would be needed to compensate for this settlement. Montana Tunnels would establish a 100-foot by 100-foot survey grid on the tailings storage facility surface after operations cease and before the cap rock is placed. Then as the cap rock is placed, the grid would be checked to ensure the required amount of cap rock and the desired grade are achieved. Montana Tunnels would have to wait until the majority of settlement occurred, about 5 years, before the 24 inches of soil is placed. The grid would be checked again to verify the desired grade. Any long-term continued settlement would require additional soil to be placed

to reestablish the grade. Montana Tunnels would report the results of the survey annually in the annual report to the agencies and provide documentation that the reclamation gradient has been reestablished on the tailings storage facility surface (Issue A).

Waste Rock Storage Areas

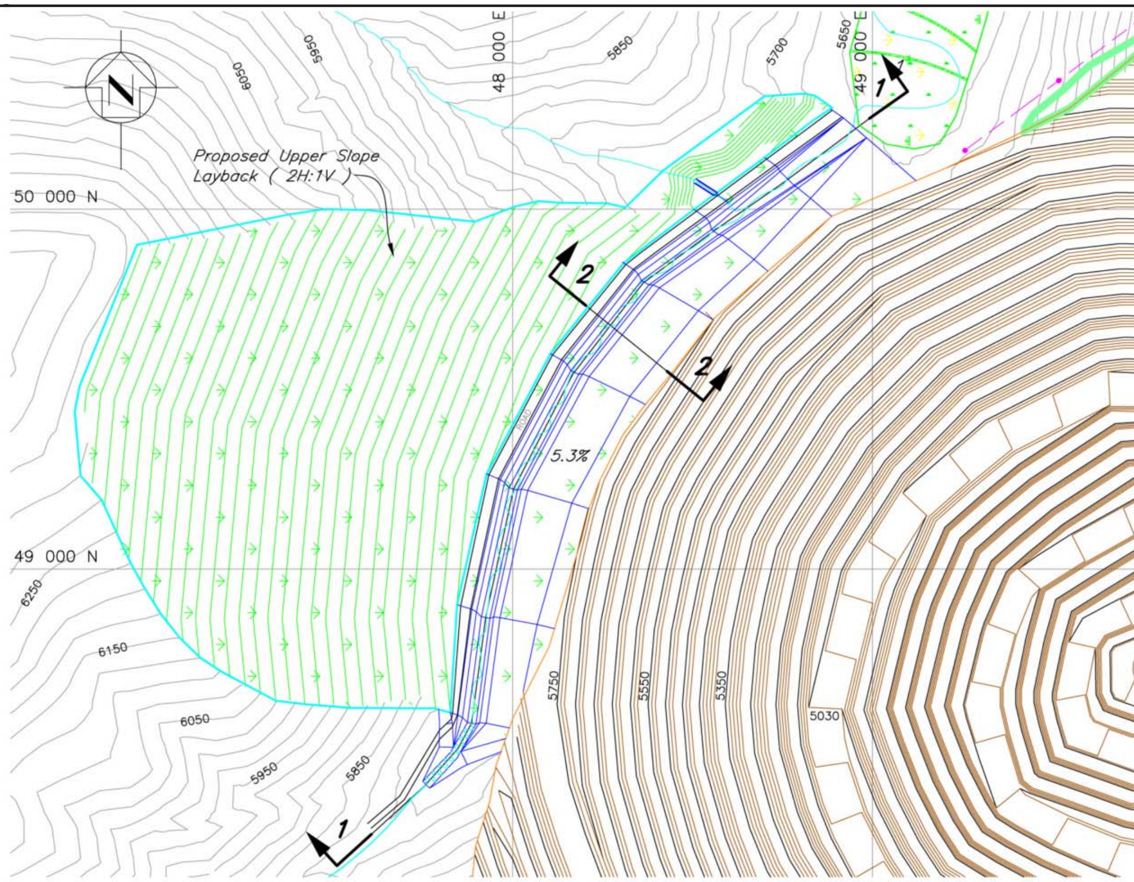
- Montana Tunnels would use a maximum waste rock storage area lift height of 50 feet during construction to improve compaction and facilitate construction of cells to encapsulate acid-generating waste rock, as in Alternative 1. This requirement would not adversely impact the stability of the waste rock storage area due to a projected increase in compaction of the waste rock. This requirement would probably increase the stability in both the short and long term. (Issue C).

- Montana Tunnels would use a dendritic drainage pattern on the reclaimed dump surface, eliminating benches. Waste rock storage areas would be constructed with a concave slope, steeper at the top and less steep at the bottom. These reclamation techniques would provide a more natural looking and functioning system, help to mitigate and lessen impacts to soils and vegetation, and improve reclamation success (Issue C).

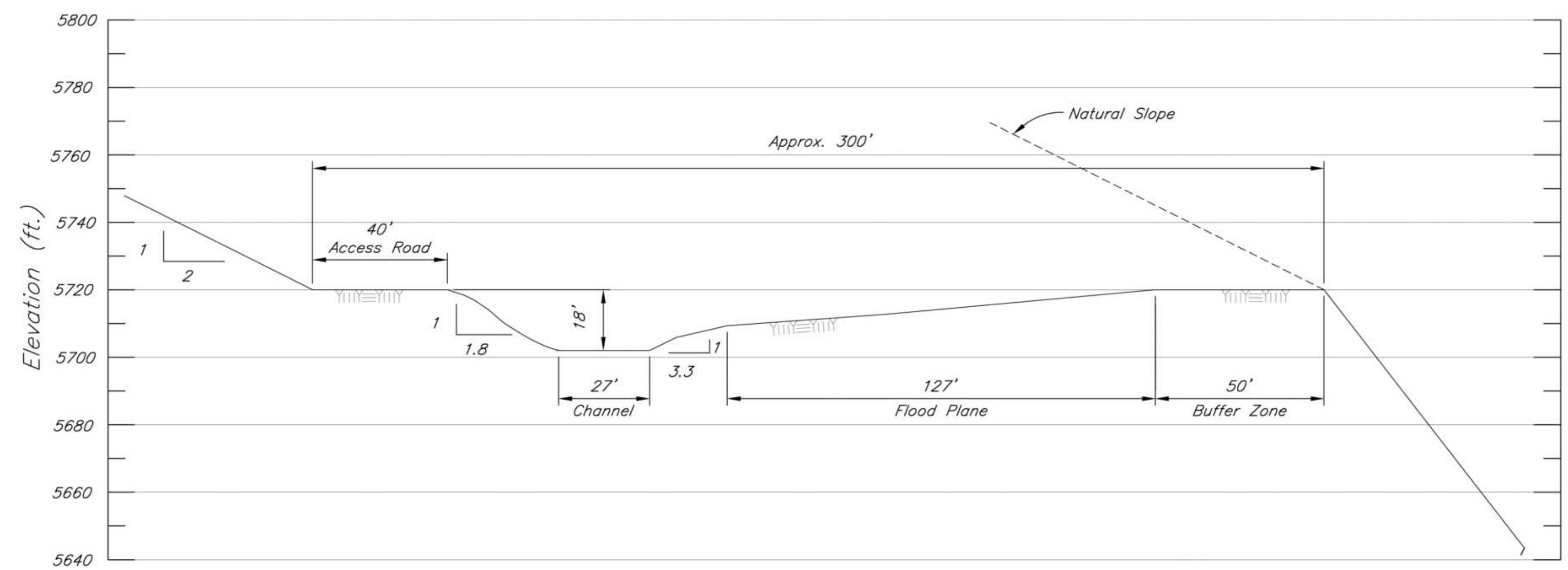
Clancy Creek Relocation

- The hillside above the existing Clancy Creek channel in the vicinity of the mine pit (36.9 acres) would be laid back at the beginning of the M-Pit Mine Expansion (**Figure ES-3**). After excavation of the layback and stream channel bench is complete, an open-flow channel would be constructed within the bench and around the M-Pit that would mimic the present Clancy Creek channel. The new channel would be lined to limit seepage. The overall goal would be create a stable stream channel that would convey a design flow equal to the 1 in 20 year return period 24 hour storm event. Excess storm flow would be diverted in to the M-Pit (Issue E).

- A conceptual section of a recommended closure layback bench would include a bench width (from layback toe to pit rim) equal to 300 feet with a 50-foot-wide rockfall protection zone with a single track roadway, a 50-foot channel width, a 200-foot-wide buffer zone to the pit rim, and appropriate groundwater cutoff and collection measures for the reconstructed Clancy Creek channel (Issue F).



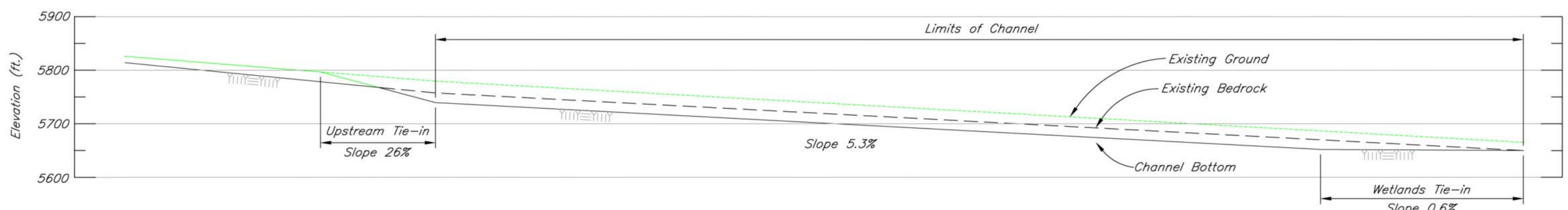
DIVERSION CHANNEL PLAN
Scale A



SECTION 2
Scale C

NOTE:

1. Pit plan provided by MTMI (July 2007).



SECTION 1
Scale B

C 125 0 125 250 375 Feet
B 25 0 25 50 75 Feet
A 250 0 250 500 750 Feet

FIGURE ES-3
Clancy Creek Diversion Channel Design
Conceptual Plan and Sections

Montana Tunnels Project

Once vegetation for the constructed open-flow channel and wetlands mitigation area has begun to establish itself, flow in the existing Clancy Creek channel would be routed into the new channel at a point of diversion on Clancy Creek upstream of the mine pit. It is anticipated that activities related to the hillside layback, channel construction, wetlands mitigation, slope reclamation, and re-routing of the existing Clancy Creek would begin immediately upon initiation of M-Pit activities, and would be completed in less than 2 years. The restored channel area would be fenced to discourage livestock grazing and other channel disturbances in order to preserve habitat in the long-term (Issue E).

- Montana Tunnels would implement operational open pit mining measures to achieve and maintain long-term Clancy Creek stability after closure as outlined in the Knight Piésold stability assessment (Montana Tunnels 2007). In part, stability requirements include low-damage blasting practices, aggressive groundwater depressurization, and implementation of a proactive geotechnical monitoring program. These practices would ensure that the reconstructed Clancy Creek channel and design flow do not enter the M-Pit in the future (Issue F).
- Similar to Alternative 2, a wetlands mitigation area would be developed on Clancy Creek downstream of the M-Pit mine (Issue E).

Geochemical Verification Program

- Montana Tunnels would develop a contingency plan and operational geochemical verification program to handle potentially acid-generating waste rock based on kinetic test results, and on-going monitoring of waste material mined from the M-Pit Mine Expansion zone. Selective handling criteria based on these test results must meet timely material handling requirements in the proposed M-Pit mine plan (Issue D).
- Montana Tunnels would continue to test the geochemistry of the ore, tailings, and waste rock during operations. The predictions of the existing geochemical model(s) would be verified based on operational geochemical data and testing. Geochemical models would be rerun with newly collected operational data to verify existing model results (Issue D).
- Montana Tunnels would monitor tailings storage facility seepage water quality for selected geochemical parameters during tailings consolidation and dewatering (tailings consolidation would occur during the 5-year closure period and is anticipated to continue for several decades thereafter) to evaluate the potential for oxidation of tailings material and future acid rock drainage. (Issue A).

- Montana Tunnels would collect operational geochemical data and conduct testing on material from the layback required to construct the Clancy Creek closure channel to assess potential long-term Clancy Creek water quality issues (Issue D).

- Montana Tunnels would monitor tailings water discharged to the pit and post-mining pit lake water quality during the 5-year closure period to verify tailings storage facility seepage water quality predictions, and to verify impacts related to pit lake water quality. All water quality and geochemical data would be evaluated at the end of the 5-year closure period, and the monitoring program requirements would be adjusted by DEQ and BLM, as needed. The monitoring program would continue to be implemented for a time period determined appropriate by DEQ and BLM. (Issue A).

Operational Water Quality Verification Program

- Montana Tunnels would conduct an operational verification program to monitor tailings storage facility leachate quality and pit water quality during the 5-year closure period to verify estimates of seepage and pit lake water quality made in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Water quality samples from the combined drains and pit lake would be collected using the laboratory analytical list provided in **Table 3.6-3** and pit lake elevations provided in **Table 2.2-3**. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The existing models would be calibrated using newly collected operational data. The calibrated models would be rerun and if necessary, pit water or tailings storage facility leachate would be managed or treated, as appropriate (Issue D).

- At the end of the 5-year closure period, Montana Tunnels would breach the south pond liner and bury the south pond only if pond water quality meets DEQ-7 standards. If the operational verification program indicated tailings storage facility seepage was worse than predicted in this EIS, the pond liner would not be breached and tailings storage facility seepage would continue to be pumped into the pit or treated, if necessary. Additionally, a recovery well system would be operated to prevent contaminant migration in groundwater, if necessary (Issue D).

Fisheries and Aquatics Resources

- Clancy Creek would be routed to a constructed open-flow channel soon after commencing the M-Pit Mine Expansion rather than into a 2,000-foot-long, 16-inch-diameter high-density polyethylene pipe so that habitat would remain connected (Issue E).

- The new channel area would be fenced to discourage livestock grazing and other channel disturbances in order to preserve habitat in the long-term (Issue E).

- The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future (Issue E).

Wildlife Resources

- Motorized travel in important winter and summer ranges would be limited which would be beneficial to deer and elk (Issue G).
- As for Alternative 2, the mill, warehouse, office buildings, laboratory, and two outside storage buildings would be donated to the Jefferson Local Development Corporation, but with the additional requirement of using only existing building sites and reclaiming other areas to decrease impact to wildlife (Issue G).

Cultural Resources

- If the M-Pit expansion adversely impacts 24JF1825, an MOU between Montana Tunnels, the BLM and the Montana State Historic Preservation Office would be developed to mitigate those impacts (Issue G).

Comparison of Alternatives and Impacts

A summary of the effects of implementing each alternative is provided in **Table ES-1**. Information presented in **Table ES-1** is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among Alternative 1 - No Action Alternative (L-Pit), Alternative 2 - Proposed Action Alternative (M-Pit), and Alternative 3 - Agency Modified Alternative.

Identification of Preferred Alternative

The rules and regulations implementing MEPA and NEPA (ARM 17.4.617 and 40 CFR 1502.14, respectively) require that the agencies indicate a preferred alternative in the Draft SEIS, if one has been identified. Stating a preference at this time is not a final decision. The preferred alternative could change in response to public comment on the

draft EIS, new information that becomes available, or new analysis that might be needed in preparing the final EIS. The preferred alternative at this time is Alternative 3 - Agency Modified Alternative.

Rationale for the Preferred Alternative

Alternative 3 was developed by the agencies to address all issues raised during the public scoping process and to mitigate to the extent possible, those environmental impacts identified in Chapter 3 of this EIS. Alternative 3 is the preferred alternative because it results in less environmental impact than Alternative 2. Alternative 3 also results in greater economic benefits than Alternative 1 because it allows Montana Tunnels to expand the existing mine pit to access and mine additional ore resources.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
	General Impact		
Resource, Land Use, or Activity	**Alternative 1 - No Action Alternative (L-Pit)**	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Disturbed Acreage Waste Rock Storage Areas	425.9 acres	579.1 acres	579.1 acres
Cap Rock and Low Grade Stockpiles	66 acres	68.3 acres	68.3 acres
South Pond and Tailings Storage Facility Embankment Top	22.7 acres	24.7 acres	24.7 acres
Tailings Storage Facility	259.3 acres	272.6 acres	272.6 acres
Open Pit	248.4 acres	287.7 acres	287.7 acres
Pit Perimeter	16 acres	11.1 acres	54.2 acres
Facilities	37.6 acres	37.6 acres	37.6 acres
Gravel Pit Area	33.1 acres	0.0 acres	0.0 acres
Soil and Gravel Stockpiles	59.6 acres	115.3 acres	115.3 acres
Roads and Miscellaneous	30.9 acres	55.8 acres	55.8 acres
Total Acres	**1,199.5** acres	**1,452.2** acres	**1,489.1** acres
Geology and Minerals	Mining continues through 2009. L-Pit mine (248.4 acres); waste rock stored in a 425.9 acre waste rock storage area; milled ore wastes deposited in a 259.3 acre tailings storage facility.	Mining continues through 2013. Larger (+16%) M-Pit mine, larger waste rock storage area (+36%) and larger (+5%) tailings storage facility.	Same as Alternative 2 except waste rock volume would increase from the hillside layback.
	No hillside layback required to reroute Clancy Creek.	Same as Alternative 1.	A 36.9-acre layback of the hillside northwest of the mine pit adjacent to Clancy Creek would be required to route the creek into a constructed open-flow channel.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geotechnical Engineering	Erosion of the L-Pit highwalls and raveling of material onto benches would occur. Potential for smaller scale slope failures on pit highwalls and release of rock into the L-Pit similar to the failures that have previously occurred during operations.	Similar to Alternative 1, except that M-Pit Mine Expansion would expose weaker rock within some of the highwall resulting in more potential minor highwall instability problems.	Similar to Alternative 2, except that a higher level of blasting control would be used to minimize potential stability problems with the M-Pit highwall.
	The Clancy Creek channel would not be disturbed.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a 2,000-foot pipe around the M-Pit.	For increased stability, Clancy Creek would be routed to a constructed open-flow channel which would require a 36.9-acre layback of the hillside near the M-Pit. Appropriate operational and geotechnical measures would be implemented to achieve and maintain stability of the relocated Clancy Creek channel.
	A maximum waste rock storage area lift height of 50 feet would be used during construction to improve compaction.	A maximum waste rock storage area lift height of 150 feet would be used during construction.	Same as Alternative 1.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Soil, Vegetation, and Reclamation	Soil impacts result from the removal, storage, and replacement of soil during mining and include loss of soil development and horizonation, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of impacts determines, in part, the potential success of reclaiming the areas to forested areas, grasslands, and wildlife habitat. Ongoing reclamation has successfully reestablished a grassland vegetation cover.	Soil and vegetation impacts would be similar to those described under Alternative 1 but would apply to a larger area of disturbance. Soil would be salvaged from an additional 540 acres for a total disturbance of 1,452.2 acres. Soil would be redistributed on an additional 191 acres for a total of approximately 941 acres. The revegetation plan for Alternative 2 contains the same seed mixtures and plant communities as Alternative 1.	Similar to Alternative 2, except the sides of the waste rock storage areas would be regraded with concave slopes and a dendritic drainage pattern.
	The Clancy Creek channel would not be disturbed.	Clancy Creek in the vicinity of the M-Pit would be routed in a combination 2,000-foot-long pipe and 600-foot lined channel, and a wetlands mitigation plan would be implemented along Clancy Creek downstream of the M-Pit.	Similar to Alternative 2, except Clancy Creek would be routed in a constructed open-flow channel that would be designed to mimic the existing stream channel.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Geochemistry	Waste rock and ore mined under the Alternative 1 (L-Pit) and Alternative 2 (M-Pit) plans would behave similarly from a geochemical perspective. Static acid-base accounting (ABA) testing suggests the potential for acid generation from ore and waste rock exists, especially for materials excavated from depths below 5,100 feet. These data are conservative as shown by kinetic tests that consistently fail to produce acid from samples classified as acidic based on ABA data and a history of 20 years of mining which has not produced acid. Acid generation is not predicted.	Similar to Alternative 1 except that as the M-Pit deepens the potential for acid generation may increase.	Similar to Alternative 2 except that ore and waste rock encountered at depth would be further evaluated through an operational geochemical verification program that includes a more detailed sampling plan and kinetic testing.
	The L-Pit lake is predicted to have elevated concentrations of iron, sulfate and cyanide for about a decade after pit filling begins, and manganese is predicted to exceed the SMCL for almost two centuries.	The M-Pit lake is predicted to have elevated concentrations of cadmium, sulfate, and cyanide for about a decade, and manganese is predicted to exceed the SMCL for about two centuries.	Same as Alternative 2.
	Waste rock has the potential to release manganese.	Same as Alternative 1.	Same as Alternative 1 except that an alternative waste rock handling program would be implemented, if necessary.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geochemistry (Cont.)	Tailings have the potential to release iron, manganese, sulfate and cyanide.	Same As Alternative 1.	Same as Alternative 1, except that an alternative tailings facility closure plan would be implemented as follows:
			(1) Montana Tunnels would conduct kinetic oxidation tests to evaluate these possible changes for the existing tailings, for the tailings with M-Pit Mine Expansion material included, and for the tailings with M-Pit combined with Elkhorn Goldfields material. If these tests indicate differences from water chemistry predicted in this EIS, alternative capping strategies for tailings would be considered to limit oxygen flux and neutralize any acidity resulting from oxidation.
			(2) If Elkhorn Goldfields tailings are found to generate acid or produce elevated metals concentrations, Montana Tunnels would either refuse to mill Elkhorn Goldfields ore or would construct a separate tailings storage facility to segregate the tailings from material in the existing tailings storage facility. This new facility would have to be analyzed and approved in another environmental analysis.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Groundwater	Groundwater would flow into the L-Pit for almost two centuries, and would create a post-mining pit lake about 1,360 feet deep (L-Pit lake equilibrium surface at 5,610 feet minus the pit bottom at 4,250 feet). The L-Pit would not completely fill. Seepage from the L-Pit (7 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Groundwater would flow into the M-Pit for about two centuries, and would create a post-mining pit lake about 1,575 feet deep (M-Pit lake equilibrium surface at 5,625 feet minus the pit bottom at 4,050 feet). The M-Pit would not completely fill. Seepage from the M-Pit (at least 360 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Similar to Alternative 2, except that seepage from the M-Pit to groundwater in the Spring Creek drainage would be less because there would be no surface water inflow to the mine pit from Clancy Creek.
	After mining ceases, runoff from the reclaimed tailings surface and tailings storage facility seepage would be routed to the percolation pond created in the reclaimed south pond, and then infiltrated to groundwater in the Spring Creek drainage.	After mining ceases, runoff from the reclaimed tailings surface would be routed to the M-Pit. Tailings storage facility seepage would be routed the same as in Alternative 1.	Same as Alternative 2, except if there are elevated concentrations of metals or cyanide in the tailings storage facility seepage, seepage would be managed or treated until it can be discharged to the percolation pond as in Alternatives 1 and 2.
	Seepage from the waste rock storage area would infiltrate to the Spring Creek drainage.	Same as Alternative 1.	Same as Alternative 1.
	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase.	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Groundwater (Cont.)	The Clancy Creek alluvium and aquifer would not be disturbed.	Approximately 1,800 linear feet of alluvium and aquifer associated with Clancy Creek on the northwest side of the mine pit would be excavated and removed.	Same as Alternative 2.
	No operational verification program of L-Pit lake water quality or seepage from the tailings storage facility would be implemented.	Same as Alternative 1 for the M-Pit.	An operational verification program would be implemented to verify estimates of M-Pit lake water quality and seepage from the tailings storage facility made in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The models would be calibrated using operational data. The calibrated models would be rerun, and, if necessary, pit water or tailings storage facility leachate would be managed or treated, as appropriate.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Surface Water	The Clancy Creek channel would not be disturbed and the current flow regime in Clancy Creek would not be altered.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a combined 2,000-foot pipe and 600-foot lined channel near the mine pit.	Similar to Alternative 2, except that Clancy Creek would be routed to a constructed open-flow channel around the northwest side of the mine pit soon after commencing the M-Pit Mine Expansion. This constructed channel would be designed to mimic the existing stream channel.
	During operations, 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow would be appropriated from Clancy Creek at a point of diversion downstream of Kady Gulch. Up to 1,000 gpm (2.2 cfs) would be appropriated from Spring Creek.	Same as Alternative 1.	Same as Alternative 1.
	The Pen Yan Creek channel has been permitted for diversion but would not be disturbed in the L-Pit plan.	Approximately 3,800 feet of the existing ephemeral Pen Yan Creek channel would be covered with waste rock and the channel would be realigned.	Same as Alternative 2.
	After mining ceases, flows from Clancy Creek would not be used to fill the L-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would be used to fill the M-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would not be used to fill the M-Pit to accelerate pit lake filling.
	The concentration of sulfate in Spring Creek would temporarily increase.	The concentration of sulfate in Spring Creek would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Wetlands	There are no direct impacts to wetlands.	Mining would impact 2.63 acres of wetlands. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation. The total wetland disturbance is 4.77 acres. The total proposed migration is 5.13 acres. The proposed wetlands mitigation plan would create 3.0 acres of new wetlands to replace the 2.63 acres of wetlands impacted by the M-Pit Mine Expansion for an average replacement ratio of 1.14 to 1.	Similar to Alternative 2, except there is potential for some additional wetlands to reestablish along the constructed open-flow channel for Clancy Creek.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Wildlife	Effects resulting from altered habitats (L-Pit, waste rock storage areas, tailings storage facility), including reclaimed sites, would persist. Mining has destroyed pre-mining wildlife habitat. Some animals seem to have habituated to mine-related activity. The quality of wildlife cover in reclaimed lands has been lowered due to reduced amounts of shrubs and conifers. Some animals, however, may benefit from the increased acreage of grassland foraging habitat.	Similar to Alternative 1, except additional impacts would be additive to those that have already occurred. Impacts primarily would be additional loss of wildlife habitat mostly through expansion of the mine pit and waste rock storage areas and redisturbance of reclaimed waste rock storage acres.	Same as Alternative 2, except that limiting motorized travel in important winter and summer ranges would be beneficial to deer and elk; and donating the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation but with the requirement of using only existing building sites and reclaiming other areas would result in less impact to wildlife.
	Total area disturbed is 1,199.5 acres.	Total area disturbed is 1,452.2 acres.	Total area disturbed is 1,489.1 acres.
Fisheries and Aquatics	Short-term impact to aquatic habitat associated with appropriation of 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow in Clancy Creek at a point of diversion downstream of Kady Gulch. No long-term impacts to fisheries and aquatic resources.	Same as Alternative 1.	Same as Alternative 1.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Fisheries and Aquatics (Cont.)	The Clancy Creek stream channel would not be impacted.	Approximately 1,800 feet of Clancy Creek channel and associated aquatic habitat northwest of the M-Pit would be excavated and removed. The channel would be replaced with a combination 2,000-foot-long, 16-inch-diameter pipe and 600-foot lined channel. There would be loss of connection with stream habitat in Clancy Creek upstream of the mine pit diversion.	Clancy Creek would be routed to a constructed open-flow channel soon after commencing the M-Pit Mine Expansion and habitat would remain connected. The restored channel area would be fenced to discourage livestock grazing and other human caused channel disturbances in order to preserve habitat in the long-term. The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future.
	No loss of habitat; the flow regime in Clancy Creek channel would not be altered.	A portion of Clancy Creek would be diverted into the M-Pit. There would be the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek.	Only flood events greater than the 1 in 20 year return period 24 hour storm event would be diverted to the M-Pit. No loss of habitat in Clancy Creek is anticipated.
Socioeconomics	Loss of approximately 180 full time jobs and 35 part time jobs in 2009.	Economic benefits of the mine extended 4.5 years to 2013.	Same as Alternative 2.
	Loss of about $2.5 million in annual wage income above county average wages in 2009. Loss of secondary benefits to local businesses in 2009.	Loss of jobs, income and secondary benefits mentioned in Alternative 1 would occur in 2013 rather than 2009.	Same as Alternative 2.

TABLE ES-1 SUMMARY OF IMPACTS FROM ALL ALTERNATIVES			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Socioeconomics (Cont.)	In 2009, loss of mine-generated tax revenue.	About $9.5 million more in taxes revenues would be generated through 2013 compared to Alternative 1.	Same as Alternative 2.
	Additional metals would not be extracted from the mine after 2009.	Additional metals would be extracted from the mine until 2013.	Same as Alternative 2.
	Road maintenance and recreation costs would end in 2009.	Road maintenance and recreation costs would be slightly higher than under Alternative 1.	Same as Alternative 2.
Cultural Resources	Eight previously documented historical mining sites have already been recorded and mitigated through photographic documentation.	Three sites (24JF1826, 24JF1823, and 24JF1824) have been determined "not eligible" for listing on the National Register of Historic Places and would not be adversely affected by mine operations. Site 24JF1825 has been determined "eligible."	Same as Alternative 2.

Notes:
Cont. = Continued

Purpose of and Need for Action

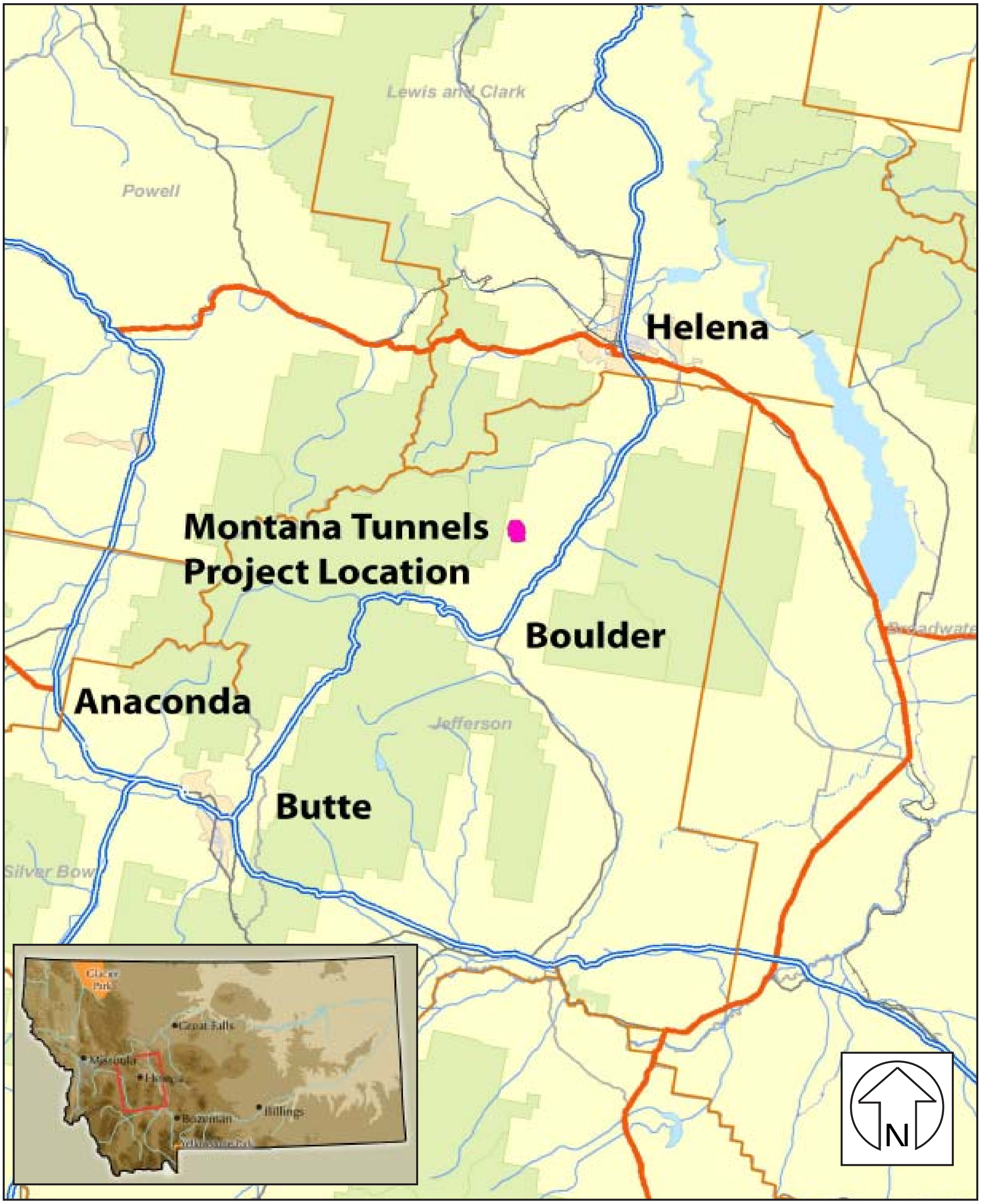
1.1 Introduction

This draft environmental impact statement (EIS) has been prepared for the proposed M-Pit Mine Expansion at the Montana Tunnels Mining, Inc. (Montana Tunnels) Montana Tunnels Mine in Jefferson County, Montana (**Figure 1.1-1**). The Montana Department of Environmental Quality (DEQ) and the U.S. Bureau of Land Management (BLM) are co-lead agencies preparing the impact analysis. The U.S. Army Corps of Engineers (Corps of Engineers) is a cooperating agency on this EIS. The EIS for the M-Pit Mine Expansion at the Montana Tunnels Mine presents the analysis of possible environmental consequences of three alternatives: Alternative 1 - No Action Alternative (L-Pit), which is Montana Tunnels' present Operating Permit 00113 for the L-Pit Plan; Alternative 2 - Proposed Action Alternative (M-Pit), which is the Montana Tunnels Proposed Action for the M-Pit Mine Expansion; and Alternative 3 - Agency Modified Alternative, which is the agency-modified alternative including mitigations. The three alternatives are described in detail in Chapter 2 of this EIS.

1.2 Purpose and Need

Montana Tunnels currently mines ore containing gold, zinc, lead, and silver from an open pit (mine pit) under Operating Permit 00113, issued by the State of Montana under the Montana Metal Mine Reclamation Act ([MMRA]; 82-4-301 *et seq.*, Montana Code Annotated [MCA]), and under Plan of Operations No. MTM 82856, issued by BLM, referred to as "Operating Permit" throughout this EIS. Montana Tunnels wants to expand the existing mine pit to access and mine additional ore resources.

Montana Tunnels has applied to DEQ and BLM for an amendment to its operating and reclamation plans. Proposed adjustments to the Operating Permit include increasing the permitted area and depth of the mine pit, expanding waste rock disposal areas, raising the tailings storage facility embankment, realigning a portion of the Jefferson County mine access road, diverting the course of two stream channels, and creating new soil stockpiles. Montana Tunnels proposes to extend operations by almost 5 years beyond the approved L-Pit plan. The reclamation plan changes include routing additional stormwater to the mine pit to aid flooding of a post-mining pit lake. In addition, Clancy Creek would be diverted around the expanded M-Pit during operations. After mining is complete, a portion of the flow in Clancy Creek adjacent to the mine pit would be diverted into the pit until the M-Pit has filled and reached equilibrium at elevation 5,625 feet, or about 25 feet below the elevation of Clancy Creek (5,650 feet).



SCALE: 1” = 15 miles (approx.)

Interstate

Secondary Road

Secondary Access Road

County Line

FIGURE 1.1-1
Project Location Map

Montana Tunnels Project

Montana Tunnels also proposes to donate several buildings including the mill, warehouse, office, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation for post-mining economic development. These changes constitute a major amendment to Montana Tunnels' operating and reclamation plans.

The Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA) and their implementing rules and regulations require that if actions taken by the State of Montana and BLM may significantly affect the quality of the human environment, then an EIS must be prepared. This EIS was written to fulfill the requirements of these laws. The DEQ Director and the BLM Field Manager will use the EIS to decide which alternative should be approved.

1.3 Project Location and History

The Montana Department of State Lands (DSL), now DEQ, wrote a draft EIS on the proposed Montana Tunnels Mine in 1985 (DSL 1985). The draft EIS was adopted as the final EIS by way of a Notice of Adoption that was published in January 1986 (DSL 1986). The Record of Decision was issued in February 1986, approving the project. Since 1986, Montana Tunnels has applied for and received 32 amendments and revisions to Operating Permit 00113 (**Table 1.3-1**). Subsequent environmental assessments (EA) have been prepared on the larger amendments (**Table 1.3-2**). This draft EIS is tiered to past environmental documents.

1.4 Scope of the Document

The three alternatives are described in Chapter 2 of this EIS. The existing environment that would be affected by the alternatives as well as an assessment of environmental impacts is presented in Chapter 3. Resource areas that are discussed in detail in this EIS include: geology and minerals; geotechnical engineering; geochemistry; surface water and groundwater (including water quantity and quality issues); biology, including wildlife, threatened and endangered species, fisheries and aquatics; reclamation; wetlands; socioeconomics; and cultural resources.

1.5 Agency Roles and Responsibilities

Department of Environmental Quality

DEQ administers the MMRA, the MEPA, the Montana Hazardous Waste Act, the Montana Water Quality Act, the Clean Air Act of Montana, and the Montana Solid Waste Management Act.

TABLE 1.3-1
SUMMARY OF AMENDMENTS, REVISIONS AND BONDING - MONTANA TUNNELS OPERATING PERMIT 00113

Permit & Bond Modifications	Change	Date Approved	Total Bond Posted
Operating Permit	Record of Decision	02/20/86	$1,512,400
00113 Amendment 001	Relocation of Plant Site	Undated	
Amendment 002	Facilities Relocation, Reduce Permit Area	05/01/86	
Revision 88-001	Construction of West Pond & Water Supply	08/19/88	
Revision 88-002	Construct Zinc Loadout Facility	11/18/88	
Revision 89-001	Store Reclaim Water in West Pond	03/27/89	
Amendment 003	Upstream Embankment Construction Expand	04/13/90	
Amendment 004	Permit Boundary -South Highwall Modify	04/06/93	
Amendment 005	Waste Rock Storage Areas/Revise Bond	01/19/94	$6,872,000
Revision 94-001	Power Line Relocation	05/04/94	$6,900,700
Amendment 006	Raise Tailings Embankment Height	02/28/95	$10,570,700
Revision 95-001	Road Construction and Soil Stockpiles	05/30/95	$10,580,700
Revision 96-001	Relocate Explosives Storage Area Road Add	06/10/96	
Revision 97-001	Power Line to North Pit Area	03/13/97	$10,594,700
Revision 97-002	Diamond Hill Ore Storage Area Expansion	03/27/97	$10,596,569
DEQ 5 Yr Bond	Draft Bond Recalculation	09/04/97	$15,767,000
DEQ Bond Revision	Revise Bond Estimate/MTMI Comments Add	11/13/97	$15,767,000
Revision 97003	Pit Reclamation to Reflect Bond	12/01/97	$15,767,000
Revision 97004	East Pit Highwall Layback	03/06/98	$15,767,000
Revision 98001	Northwest Pit Highwall Stabilization	04/02/98	$15,767,000
Revision 98-002	Diamond Hill Concentrate Leach Process	07/23/98	$15,767,000
DEQ Bond Review	Draft 5-year Bond Recalculation	02/26/99	$15,767,000
Revision 99-001	Relocate Diamond Hill Ore Crushing to GP	04/23/99	$15,767,000
Bond Adjustment	Appeal of 5-year Bond Review	07/07/99	$14,450,000
Revision 99-002	Increase Ore Stockpile Area	12/28/99	$14,456,400
Revision 00-001	Upper Corbin Waste Repository on Dump 6	03/10/00	$14,456,400
Revision 01-001	Gregory Waste Repository on Dump #6	10/02/01	$14,456,400
Amendment 007	Tailings Embankment Raise to 5640'	03/22/02	$14,987,688
Revision 02-001	Soil Pile, Power Line, Primary Crusher	08/29/02	$14,987,688
Revision 02-002	Southwest Pit Highwall Layback	11/08/02	$14,987,688
Revision 03-001	Dump 6 Haul Road	02/26/03	$15,025,059
Revision 03-002	Primary Crusher Installation	04/24/03	$15,031,199
Bond Review	5-Year Bond Review/Amendment 007	02/26/03	$15,328,111
Revision 03-003	Pit Haul Ramp West Notch Waste Rock	11/06/03	$15,413,297
Inflation Increment	5-Year Bond Review Inflation Increment	02/20/05	$15,888,955
Revision 04-001	Gravel Pit Expansion	05/03/05	$15,903,846
Inflation Increment	5-Year Bond Review Inflation Increment SE	04/19/05	$16,381,278
Revision 05-001	Wall Layback – Ramp Remediation	12/20/05	$16,760,746
Inflation Increment	5-Year Bond Review Final Inf. Increment	05/17/06	$18,125,177
Revision 06-001	Tailings Embankment Raise to 5660′	10/20/06	$18,368,554
Revision 07-001	SW Wall Layback	03/21/07	$18,692,193

Notes: MTMI = Montana Tunnels
Tailings embankment = Tailings storage facility embankment

TABLE 1.3-2
Summary of Amendments to Montana Tunnels Operating Permit 00113

Permit/Amendment/ Minor Revision	Date	Action
Operating Permit 00113	February 20,1986	Open pit mine, waste rock storage area, tailings storage facility, and mill permitted; permit area 1,500 acres, 965 disturbed acres. A draft EIS was released in November 1985. Adopted as final EIS January 31, 1986.
Amendment 001	undated	Plant site relocated to match EIS. No change in permitted or disturbed acres. No environmental assessment (EA) was completed.
Amendment 002	May 6, 1986	Permit area decreased to 1,497 acres. Miscellaneous changes in facility locations and production levels. No EA was conducted because of the lack of impacts.
Minor Revision 88-001	May 23, 1988	Changes to tailings embankment design, tailings discharge system, south pond, and monitoring wells below the south pond. No EA was completed.
Minor Revision 88-002	August 19, 1988	Freshwater storage pond and water supply system. No changes to permit area or impacts. No EA was completed.
Minor Revision 89-001	March 27, 1989	Reclaim water stored in west pond. No EA was completed for the revision.
Amendment 003	April 13, 1990	Tailings embankment design changed and steepened to 1.75:1. Permit area 1,546 acres. Disturbed acres increased to 1,060 acres. An EA was completed April 12, 1990.
Amendment 004	May 11, 1993	Two haul roads and cap rock stockpile approved. Permit area increased to 1,606 acres. Disturbed acres increased to 1,086. An EA was released on April 16, 1993.
Minor Revision 93-001	Nov. 29, 1993	Historic Diamond Hill Mine materials deposited at Montana Tunnels waste rock storage area. No EA needed for 1,800 cy of material.
Minor Revision 93-002	Dec. 21, 1993	Disposal of Washington Mine waste in waste rock storage area. No EA needed for 220,000 cy of material.
Amendment 005	January 24, 1994	Redesign of waste rock storage area and segregation of waste rock approved. New computer generated maps corrected permit area and disturbed acreages. Permit area expanded to 1,811 acres to encompass a water return line. Disturbed acres decreased to 1,033 acres. An EA was released on October 7, 1993.
Minor Revision 94-001	May 3, 1994	Power line road relocation. No EA needed.
Amendment 006	February 28, 1995	A tailings storage facility expansion and embankment raise to 5,600 feet was approved. No change in permitted acres. Disturbed acres increased to 1,106 acres. An EA was released on December 9, 1994.

TABLE 1.3-2 (Cont.)
SUMMARY OF ENVIRONMENTAL REVIEWS PREPARED FOR LARGER AMENDMENTS TO MONTANA TUNNELS OPERATING PERMIT 00113

Permit/Amendment/ Minor Revision	Date	Action
Minor Revision 95-001	May 1, 1995	Access road and soil stockpile revision. No EA needed.
Minor Revision 95-002	June 18, 1996	Deposit Diamond Hill Mine tailings at Montana Tunnels tailings storage facility. No EA needed.
Minor Revision 96-001	June 10, 1996	Relocate road to access explosive storage area. No EA needed.
Minor Revision 97-001	February 28, 1997	New power line to pump station. No EA needed.
Minor Revision 97-002	April 27, 1997	Diamond Hill ore stockpile expansion. No EA needed.
Minor Revision 97-003	December 1, 1997	Pit reclamation revision. No EA needed.
Minor Revision 97-004	March 6, 1998	Pit slope layback and tailings storage facility buttress. Internal Checklist EA completed.
Minor Revision 98-001	April 2, 1998	Northwest pit highwall stabilization. No EA needed.
Minor Revision 98-002	July 24, 1998	Leach Diamond Hill concentrates. No EA needed.
Minor Revision 98-003	Withdrawn	Contingency location for Clancy Creek.
Minor Revision 99-001	July 7, 1999	Relocate Diamond Hill ore crushing location. No EA needed.
Minor Revision 99-002	November 8, 1999	Expand run-of-mine ore stockpile. No EA needed.
Minor Revision 00-001	March 10, 2000	Corbin Flats tailings in waste rock storage area. No EA needed.
Minor Revision 01-001	October 2, 2001	Gregory Mine waste in waste rock storage area. No EA needed.
Amendment 007	March 22, 2002	A tailings embankment raise is approved to 5,640 feet. Permit area stays at 1,811 acres. Disturbed acres increased to 1,163.6 acres. A draft EA was released on January 18, 2002. Final EA released on March 22, 2002.

Source: DEQ, email, March 21, 2007
Notes:
EA = Environmental Assessment
EIS = Environmental Impact Statement
Tailings embankment = Tailings storage facility embankment

Federal Agencies

BLM manages federally owned lands under its jurisdiction and federally owned minerals. Montana Tunnels' use of BLM land must comply with BLM's surface management regulations (43 CFR, Subpart 3809) as well as various federal statutes, including the Mining and Mineral Policy Act of 1970, the Federal Land Policy and Management Act of 1976, the general mining laws, and NEPA. BLM reviews mining plans that disturb BLM-administered lands.

The Corps of Engineers permits discharges of dredged or fill materials into wetland and non-wetland Waters of the U.S. under Section 404 of the Clean Water Act. The Corps of Engineers has determined that the Clancy Creek channel and wetlands are jurisdictional pursuant to Section 404. Montana Tunnels has submitted a Section 404 permit application and wetlands mitigation plan to the Corps of Engineers. The Corps of Engineers would document its decision on the Section 404 permit in a Record of Decision. The Section 404 compliance analysis (Section 404 (b)(1) Showing) is provided in this EIS as **Appendix A**.

Other State and Local Agencies having Permit or Review Authority

In addition to DEQ, BLM, and the Corps of Engineers, other local, state, and federal agencies have jurisdiction over certain aspects of Montana Tunnels' proposed project. **Table 1.5-1** provides a comprehensive listing of agencies and their respective permit or review responsibilities with respect to the Montana Tunnels proposed M-Pit Mine Expansion.

1.6 Public Participation

The scoping process is used to identify issues relevant to the Proposed Action and to help develop alternatives. Members of the public, other agencies, and the DEQ and BLM interdisciplinary team helped to define the issues for the M-Pit Mine Expansion and the scope of analysis.

DEQ published a legal notice in local newspapers and issued a press release in September 2004 when the application was received. A news release announcing the project and the scoping meeting was published on December 15, 2004. The scoping meeting was held on January 6, 2005, in Clancy, Montana. About 100 people attended the scoping meeting. A Notice of Intent to prepare the draft EIS was published in the Federal Register on February 22, 2005. The Notice of Intent asked that scoping comments be sent to BLM and DEQ by March 24, 2005. DEQ and BLM received 76 letters and emails.

TABLE 1.5-1
AGENCIES AND THEIR RESPECTIVE PERMIT OR REVIEW RESPONSIBILITIES FOR THE MONTANA TUNNELS PROPOSED PROJECT

Permit or Review Required	Purpose of Permit or Review
Montana Department of Environmental Quality	
Operating and Reclamation Plans (Metal Mine Reclamation Act)	To allow mine development. Mining must comply with state environmental laws and regulations. Approval may include stipulations for mine operation and reclamation. A sufficient reclamation bond must be posted with the state before an operating permit or amendment is issued.
Montana Environmental Policy Act Analysis of Impacts	To evaluate possible impacts of a proposed action.
Montana Pollutant Discharge Elimination System (MPDES) (Water Quality Act)	To establish effluent limits, treatment standards, and other requirements for point source discharges to state waters including groundwater. Discharges to waters may not violate water quality standards.
Section 401 Certification (Clean Water Act)	To ensure that any activity that requires a federal license or permit (such as the Section 404 (b)(1) permit from the Corps of Engineers) complies with Montana water quality standards.
Air Quality Permit (Clean Air Act)	To control particulate emissions of more than 25 tons per year.
Bureau of Land Management	
Approval of Plan of Operations	To ensure that Montana Tunnels' use of BLM land conforms with the surface management regulations and other federal statutes such as the Mining and Mineral Policy Act of 1970, general mining laws, and the Federal Land Policy and Management Act of 1976. Compliance with the National Historic Preservation Act.
National Environmental Policy Act Analysis of Impacts	To evaluate possible impacts of a proposed action.
Corps of Engineers	
Section 404 Permit (Clean Water Act)	To control discharge of dredged or fill material into Waters of the U.S. or wetlands.
Montana Department of Natural Resources and Conservation (DNRC)	
Water Rights Permit (Water Use Act)	To allow beneficial use of state waters through a surface water diversion or through a groundwater withdrawal over 100 gallons per minute
Conservation District/Montana Fish Wildlife and Parks (FWP)	
310 Permit (Natural Streambed and Land Preservation Act)	To allow construction activities by non-government entities within the mean high water line of a perennial stream or river. FWP works with local Conservation Districts to review the permit and determine if a 318 Authorization from DEQ is needed.

1.7 Issues of Concern

The primary issues of concern raised during scoping for the Montana Tunnels M-Pit Mine Expansion pertained to six general subject areas: hydrology, wetlands and Waters of the U.S., fisheries and aquatics, wildlife, engineering, and socioeconomics. The issues are summarized below. The criteria that were used to assess the impacts to the resources under these issues are listed in Chapter 3.

Hydrology

Concerns were expressed regarding impacts to surface water and groundwater quality and quantity in the Clancy Creek, Pen Yan Creek, and Spring Creek drainages, including concerns regarding impacts to existing water rights. Concerns were also expressed regarding geochemistry and water quality of the pit lake and stormwater. Concerns were also expressed regarding the need for Montana Pollutant Discharge Elimination System (MPDES) permits, and the possible need for a water treatment plant.

Wetlands and Waters of the U.S.

Concerns were expressed regarding impacts to wetlands and Waters of the U.S., in particular Clancy Creek wetlands and streambed. Concerns were mentioned both about the loss of the actual creek streambed and the diversion of Clancy Creek water into the pit, away from the existing wetlands. Concerns were also expressed about water quality and the downstream wetlands after the pit lake reaches equilibrium.

Fisheries and Aquatics

Concerns were expressed about impacts to fisheries and aquatic insects in Clancy Creek, particularly the population of native cutthroat trout in Clancy Creek, as a result of removing the stream channel. Concerns were expressed about the viability of the fish population upstream of the proposed creek diversion, if fish have no means of swimming upstream. Concerns were also expressed regarding water quality in the pit lake and its impact to the fish and aquatic insect populations, particularly after the pit lake reaches equilibrium after mining.

Wildlife

Concerns were expressed regarding impacts to wildlife populations, including game animals, sensitive species, threatened and endangered species, and biodiversity. In particular, concerns were expressed regarding cumulative impacts to wildlife associated

with human activity on land in the vicinity of the mine. Concerns were also expressed regarding impacts to wildlife movement corridors.

Engineering

Concerns were expressed regarding impacts to pit highwall stability from allowing the pit expansion, in particular the Clancy Creek channel. Also, concerns were expressed regarding stability of the pit highwalls and the tailings storage facility in the case of an earthquake.

Socioeconomics

Concerns were expressed regarding impacts to the Jefferson County tax base, wages and benefits for the area, and schools from not permitting the mine expansion.

Cultural Resources

Four sites were recorded inside the project boundary in 2003. Three of these sites have been determined "not eligible" and therefore mining activity would have "no adverse effect" as pre 36 CFR 800.4(2). The fourth site has been determined "eligible" for listing on the National Register of Historic Places. It is within the permit boundary but not located in an area of planned disturbance.

1.8 Issues Considered but Not Studied in Detail

Soil

Soil impacts were evaluated in the 1986 final EIS, on page IV-15. Montana Tunnels salvages available soil before disturbing any new acres. In each annual report, the company provides a soil balance indicating whether or not it has sufficient soil to reclaim all disturbed acres according to the reclamation plan. Montana Tunnels had successfully reclaimed 204 acres as of the end of 2006. Montana Tunnels proposes the same soil salvage and reclamation plan as part of the proposed expansion. Montana Tunnels projects it would have adequate soil to complete the plan as proposed. The impacts to soils would be the same as analyzed in the 1986 final EIS. This issue has not been carried forward in the analysis.

Air Quality

Air quality impacts were evaluated in the 1986 final EIS, page IV-31, and in the air quality permit. The mine is currently permitted by DEQ under Air Quality Permit

#1986-10, which places limits on emissions. Montana Tunnels is not a major stationary source, so it is not subject to prevention of significant deterioration analysis.

Mining-related activities at the Montana Tunnels Mine are a source of particulate and gaseous air pollutants. Fugitive dust emissions are generated by mining, processing, hauling, and storing ore, and disposal of waste rock. Particulate emissions are controlled using best available control technology consisting of good engineering practices, including minimization of drop heights during loading and dust suppression. Gaseous pollutant emissions result from blasting, construction, mining equipment, and vehicle exhaust. These emissions are controlled using best available control technology, including proper equipment maintenance and operation. The Montana Tunnels project would continue to comply with ambient air quality standards. This issue has not been carried forward in the analysis.

Noise

Noise impacts were evaluated in the 1986 final EIS, page IV-67. Montana Tunnels is located in a mountainous rural environment. The mine has been operating continuously since 1986 and is the main contributor of noise in the area. Noise sources associated with the open pit mining and milling activities include drilling, blasting, loading, hauling, and ore processing (Montana Tunnels 2007). Noise is primarily generated by heavy equipment (haul trucks, shovels, front end loaders, rotary drills, bulldozers, graders, dump trucks, and other vehicles) and by ore processing equipment (jaw crushers, grinding and ball mills, circuit equipment, and other machinery) that is primarily located inside the ore processing buildings.

Mine-related noise levels at Wickes, the nearest community, are less than the U.S. Environmental Protection Agency (EPA) recommended day-night average noise level (L_{dn}) 55 A-weighted decibels (dBA) guideline (U.S. EPA 1979). Traffic noise levels in Wickes, Corbin, and Jefferson City, and points in between, are less than Montana Department of Transportation's (MDT) equivalent noise levels (L_{eq}) 66 dBA impact criterion (MDT 2001).

Noise impacts are not expected to change, and this issue has not been carried forward in the analysis.

Transportation

Transportation impacts were evaluated in the 1986 final EIS, page IV-61. Concerns were expressed regarding access to Bluebird and Cataract meadows and the Occidental Plateau. Concerns were also expressed regarding access to patented mining claims in the area.

A section of an unmaintained public access road at the base of the southwest extension waste rock storage area would be covered by the waste rock storage area expansion. The affected section of road would be replaced with approximately 4,000 feet of gravel road parallel to the base of the waste rock storage area. The new road would reconnect with the dirt roads that cross Wood Chute Flats and provide access to Blue Bird Ridge by way of the Pen Yan Creek valley dirt road. Otherwise, transportation impacts evaluated in the 1986 final EIS are not expected to change, and transportation has not been carried forward in the analysis.

Aesthetics

Aesthetic impacts were evaluated in the 1986 final EIS, page IV-67. Montana Tunnels is currently permitted for a total of 1,199.5 acres of disturbance. The total disturbance under the M-Pit Mine Expansion would be up to 1,452.2 acres, which includes 92.2 contingency acres of disturbance which are not likely to be used. The M-Pit Mine Expansion would increase aesthetic impacts during operations, especially from the roads accessing the nearby National Forest System lands, and for residents in Wickes. Montana Tunnels has successfully reclaimed over 200 acres during operations, minimizing impacts to aesthetics. Regrading, soiling, and revegetating the waste rock storage area, tailings storage facility, and other facilities that would be removed at closure would reduce aesthetic impacts to acceptable levels.

The mine pit would be reclaimed to a pit lake with steep sidewalls above the water level. The pit highwalls would naturally weather and ravel into the pit. The raveling of the highwalls would cover pit benches and form slopes above the pit lake resembling a naturally occurring talus slope. The additional disturbance would increase the man-made appearance of the mine site. The new access road would reduce impacts associated with unvegetated road cuts along the current access road.

Aesthetic impacts, including the impacts of a pit lake, were evaluated in the 1986 final EIS, and are not expected to change substantially. Aesthetics as a separate issue has not been carried forward in the analysis.

Paleontological Resources

No paleontological resources have been found in over 20 years of mining. The possibility of finding a paleontological resource in the increased disturbance area for the M-Pit Mine Expansion or other alternatives is low. This issue has not been carried forward in the analysis.

Areas of Critical Environmental Concern

No BLM areas of critical environmental concern would be affected by any of the alternatives.

Prime or Unique Farmlands

No prime or unique farmlands would be affected by any of the alternatives.

Wild and Scenic Rivers

No wild and scenic rivers would be affected by any of the alternatives.

Wilderness

No wilderness, wilderness study, or inventoried roadless areas would be affected by any of the alternatives.

Pit Backfill

Section 82-4-336(9), MCA, states:

> (b) With regard to open pits and rock faces, the reclamation plan must provide sufficient measures for reclamation to a condition:
>
> (i) of stability structurally competent to withstand geologic and climatic conditions without significant failure that would be a threat to public safety and the environment;
>
> (ii) that affords some utility to humans or the environment;
>
> (iii) that mitigates post-reclamation visual contrasts between reclamation lands and adjacent lands; and
>
> (iv) that mitigates or prevents undesirable offsite environmental impacts.
>
> (c) The use of backfilling as a reclamation measure is neither required nor prohibited in all cases. A department decision to require any backfill measure must be based on whether and to what extent the backfilling is appropriate under the site-specific circumstances and conditions in order to achieve the standards described in subsection (9)(b).

The M-Pit Expansion would require the excavation of 46.2 million cubic yards of waste rock and would produce an additional 24 to 28 million tons of ore. The total area of the M-Pit would increase by 39.3 acres to 287.7 acres. The maximum elevation of the pit highwall would increase to 6,450 feet.

Upon cessation of mining, the M-Pit would be reclaimed as a pit lake with steep sidewalls above the water level. Water levels would rise within the pit until the lake reached equilibrium at an elevation of 5,625 feet about two centuries after mining ceases and would not have a surface water discharge.

Structural Stability

The M-Pit Mine Expansion would likely expose weaker rock than currently exposed within some of the highwalls. Knight Piésold conducted a stability analysis of the proposed expanded mine pit and concluded that it would be necessary to reduce the overall angle of some parts of the pit highwall to minimize the potential for major highwall instability (Montana Tunnels 2007) (Table 3.3-1). Based on these proposed slopes at closure, before filling the pit, the factor of safety for the pit highwall would range from a low of 1.11 (southwest highwall) to a high of 1.33 (east and southeast highwalls), and the highwall would be stable. After formation of the pit lake, the factor of safety would increase to a low of 1.34 (southwest highwall) to a high of 1.94 (southeast highwall), increasing stability. A factor of safety of 1.3 is widely accepted for long-term stability of open pit slopes (Montana Tunnels 2007). The highwalls would be structurally stable and would not present a threat to public safety or the environment.

Utility to the Environment

The Montana Tunnels Mine was permitted to be reclaimed as a pit lake in 1986. The 1986 final EIS stated that it would be difficult to accurately predict the water quality in the pit until the pit lake reached equilibrium. Montana Tunnels speculated that the pit would likely contain a calcium-magnesium-sulfate type water with a pH below 7.0. Pit water was expected to contain concentrations of iron, manganese, and zinc between 0.5 mg/L and several milligrams per liter. Concentrations of aluminum, cadmium, copper, and lead were expected to range between a few hundredths and a few tenths of a milligram per liter (page IV-8).

Water quality monitoring in the pit during the last 20 years of operation has shown the water quality to be better than predicted in the 1986 final EIS. More recently, Montana Tunnels modeled water quality (verified by the agencies) using geochemical data collected during the 20 years of mining. This modeling also shows pit lake water quality would be better than discussed in the 1986 final EIS (see Section 3.5).

Since water quality in the pit lake is expected to be good, the pit lake would be used as a resting area for migrating birds. Bats and birds could use the pit lake as a drinking water source and feed on flying insects attracted by the water. Some birds and bats might use the pit highwalls for nesting or roosting.

Visual Contrasts

Reclamation of the mine pit would leave highwalls as rock faces. Most of the highwalls would be under water. The pit highwalls above the lake water level would naturally weather and ravel into the pit. The raveling of the highwalls would cover pit benches and form slopes above the pit lake resembling a naturally occurring talus slope. The agencies would require Montana Tunnels to seed the highwalls to control noxious weed invasion. The resulting vegetation would further reduce visual contrasts between the reclaimed pit and the surrounding landscape.

The agencies considered castblasting to accelerate raveling of the highwall. Castblasting of the highwall was discarded as a mitigation measure due to potential adverse impacts on Clancy Creek and negligible to non-existent aesthetic benefit.

While the highwalls will look like man-made features for a long time, the natural raveling of the highwall and seeding of the highwall will mitigate post-reclamation contrasts.

Undesirable Offsite Environmental Impacts

Since the quality of the pit lake water is expected to be good, and the pit lake is not expected to overflow, there would be no undesirable offsite environmental impacts.

The proposed M-Pit reclaimed as a pit lake would be structurally stable, would afford some utility to the environment, would mitigate post-reclamation visual contrasts, and would not cause undesirable offsite environmental impacts. The standards in Section 82-4-336(9)(b), MCA, would be achieved without requiring backfilling of the pit. Pit backfilling has not been carried forward in the analysis.

Invasive Non-Native Species

Vegetation impacts were evaluated in the 1986 final EIS page IV-19. Invasive non-native species are increasing throughout Montana. Montana Tunnels has a noxious weed control program and reports results in each annual report. The disturbance of additional acres would increase the risk of more weeds. Noxious weed control would continue as it has during operations. The loss of native species-dominated communities is an unavoidable impact of allowing the mine to start operations in 1986. Reclamation using native species would reduce the impacts to acceptable levels. Vegetation impacts evaluated in the 1986 final EIS are not expected to change as a result of the amendment, so this issue has not been carried forward.

Environmental Justice

As required by Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, the alternatives were evaluated for issues relating to the social, cultural, and economic well being and health of minorities and low-income groups. None of these environmental justice issues was identified. The socioeconomic impacts of any of the alternatives would not affect minority or low-income groups disproportionately.

Adequacy of Bonding

Adequate reclamation bonds are required by the MMRA and the BLM's 43 CFR 3809 surface management regulations. The agencies jointly hold a bond for the Montana Tunnels Mine in the amount of $18,125,177, a portion of which is co-obligated to cover reclamation on BLM lands. The bond was updated in 2005 as required by MMRA and BLM regulations. Adequate bond is required by MMRA and BLM's 43 CFR 3809 surface management regulations, so this issue has not been carried forward.

Water Rights

Montana Tunnels' use of water from Clancy Creek and the potential to impact existing water rights was raised as an issue during scoping. The EIS evaluates impacts on water quantity for all alternatives. Water rights holders would have to pursue action in water rights courts over any unavoidable impacts to water rights. This issue has not been carried forward in the analysis as it is outside the scope of the EIS.

Safety

Montana Tunnels is regulated by the Mine Safety and Health Administration (MSHA). This issue has not been carried forward in the analysis as it is outside the scope of the EIS.

Description of Alternatives

2.1 Development of Alternatives

Alternative 1 -No Action Alternative (L-Pit) reflects the *status quo* and serves as a benchmark against which the proposed and other alternative actions can be evaluated. For this analysis, Alternative 1 -No Action Alternative (L-Pit) is Montana Tunnels' present Operating Permit 00113 for the L-Pit Plan. This EIS evaluates Alternative 2 – Proposed Action Alternative (M-Pit), which is the Montana Tunnels Proposed Action. MEPA and NEPA require the agencies to evaluate the Montana Tunnels Proposed Action, reasonable alternatives to the Montana Tunnels Proposed Action that would fulfill its purpose and need, and the No Action Alternative. Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint, as required by NEPA and MEPA.

Important modifications to Alternative 2 were considered based on the issues raised during the public scoping process. Comments received during scoping resulted in the identification of one alternative, Alternative 3 - Agency Modified Alternative that incorporates important modifications to the Montana Tunnels Proposed Action Alternative. Other reasonable alternatives were explored and objectively evaluated. Alternatives that were eliminated from further study are discussed in Section 2.6.

Alternatives Selection Criteria

The purpose and need for the Proposed Action are described in detail in Section 1.2 of this EIS. In summary, the purpose of the M-Pit Mine Expansion is to allow Montana Tunnels to expand the mine pit to access additional ore reserves. Selection of the alternatives was based on review of baseline information, technical analysis of environmental impacts, issues raised during the public scoping process, and mandates of the laws, rules, and regulations administered by the agencies.

Issue-Driven Modifications to the Proposed Action

Issues raised during public scoping are summarized in Section 1.7. The agencies developed Alternative 3 in response to the issues of concern raised during scoping for the proposed Montana Tunnels M-Pit Mine Expansion. The public issues of concern addressed in Alternative 3 include Clancy Creek and associated wetlands reclamation, water quality in the pit lake after mining, and pit highwall stability. Additional issues raised by the agencies that are addressed in Alternative 3 include tailings storage facility seepage, wind-blown dust from the tailings surface during closure, waste rock storage areas construction and drainage, contingency planning for potentially acid-

generating waste rock, an operational geochemical verification program, and other general closure issues. These issues are discussed further in Section 2.4.

2.2 Alternative 1 - No Action Alternative (L-Pit)

Alternative 1 is the Montana Tunnels L-Pit Plan as it is presently permitted to operate by DEQ and BLM. The Montana Tunnels Mine is located in Jefferson County, Montana, approximately 25 miles south of the city of Helena (**Figure 1.1-1**). Operating Permit 00113 was granted to Centennial Minerals, Inc. on February 20, 1986. A deed transfer to Montana Tunnels Mining, Inc. was recorded on June 23, 1987.

Montana Tunnels mines ore from a mine pit and produces zinc, lead, gold, and silver in the forms of bullion and metal-sulfide concentrates for sale into commerce. The products are recovered from the ore by conventional milling and flotation processes and gravity concentrating techniques, described in the 1986 final EIS (DSL 1986). Montana Tunnels is also permitted to process gold ore from the Diamond Hill Mine, an underground gold mine near Townsend, using a combination of conventional flotation and leach recovery processes. Montana Tunnels' permitted operation is projected to last into 2009.

2.2.1 Permit Boundary and Disturbed Areas Description

The area encompassed by the permit boundary is 2,116.0 acres (**Figure 2.2-1**), as of Minor Revision 07-001. This figure shows the disturbed and undisturbed areas within the permit boundary at the time mining would cease. Based on the current approved plan, 926.0 acres of this area would remain undisturbed. The ultimate disturbed acreage of 1,199.5 acres is broken down as shown on **Table 2.2-1**. Disturbance as of the end of 2006 equals 1,190 acres (Montana Tunnels 2007).

BLM Land

Some scattered tracts of leased BLM land totaling 131.8 acres occur within the permit boundary (**Figure 2.2-1**). The permitted disturbance affects 56.7 acres of BLM land.

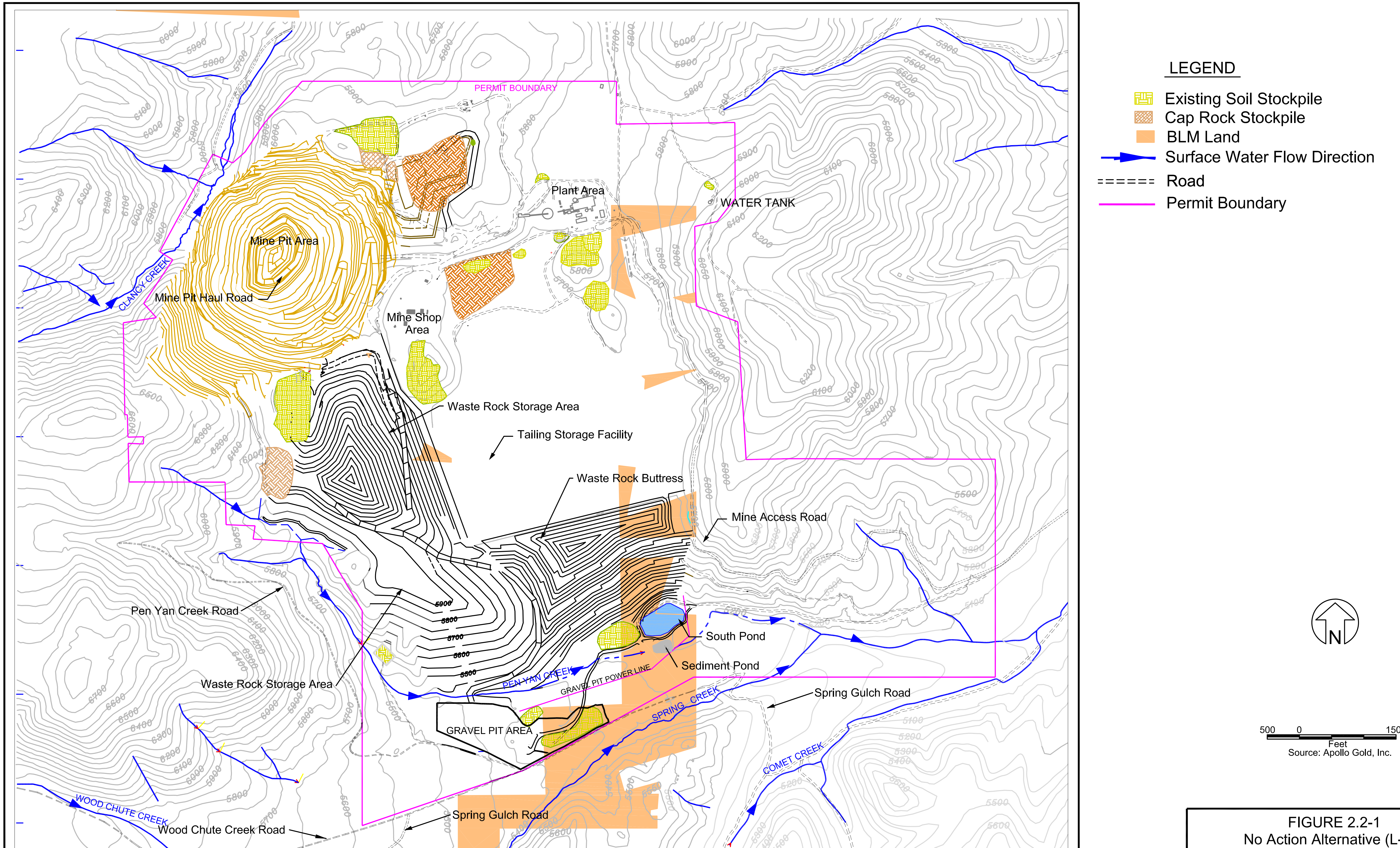


FIGURE 2.2-1
No Action Alternative (L-Pit)
Mine Features at Cessation
of Mining

Montana Tunnels Project

TABLE 2.2-1 NO ACTION ALTERNATIVE (L-PIT) PROJECTED DISTURBED ACRES AT CESSATION OF MINING	
Area	**Acres**
Waste rock storage areas	425.9
Cap rock and low grade stockpiles	66.0
South pond and associated ponds, and tailings dam top	22.7
Tailings storage facility	259.3
Pit perimeter	16.0
Facilities	37.6
Gravel pit area	33.1
Soil and gravel stockpiles	59.6
Miscellaneous (roads, air monitoring station, scale)	30.9
Mine pit	248.4
TOTAL	**1,199.5**

2.2.2 Mining Method and Pit Description

Montana Tunnels was permitted to mine an average of 15,000 tons per day (DSL 1986). The mining method has not changed since the mine was approved in 1986. The mine currently produces 11,000 to 20,000 tons of ore per day. Drilling, blasting, loading, and hauling take place on 20-foot benches as the mine pit is deepened. Projected annual ore production is 4 to 6 million tons depending on conditions through the remaining approved L-Pit Plan. The ore occurs as disseminated sulfides of lead and zinc with associated gold and silver. Gold and silver also occur as a gold/silver alloy. Mineralization generally decreases in grade from the center of the ore body outward. The cutoff grade is determined by the market price of all metals; the price of gold is an influential component of the analysis. Ore control, cutoff grade, and reserves historically have been based on a gold equivalent formula that took into account recoveries, smelter charges, mineral grades, and metal prices. Dramatic changes in any of these areas could lessen or enlarge reserves. For example, the average cutoff grade based on all economic considerations in 2004 was 0.016 ounce per ton gold equivalent (Montana Tunnels 2007); however, Montana Tunnels currently no longer establishes cutoff grade based on gold equivalent (Montana Tunnels 2007). Montana Tunnels is currently permitted to mine a total of 102 million tons of ore.

As mining continues, additional drilling may delineate new reserves deeper or peripheral to the current pit. Exploration at depth has not been completed, and additional ore reserves may be found.

The approved footprint of the mine pit is 248.4 acres. The mine pit is permitted to extend from the 6,430-foot elevation to the 4,250-foot elevation at the pit bottom (**Figure 2.2-1**). The pit rim daylight elevation (the lowest point on the rim) would be 5,670 feet

on the southeast side of the pit. The mine is accessed by a primary haul ramp on the southeast side of the mine pit.

All pit highwalls have shown instabilities except the north highwall in Lowland Creek Volcanics. If pit highwall stability is adversely affected by hydrostatic pressure, the pit highwalls would be dewatered by installing and pumping wells peripheral to the pit, by drilling horizontal drains into the pit highwall, and by reducing the highwall slope angles.

The pre-mining water table ranged from 5,650 to 5,750 feet. Water entering the pit is pumped and piped to the tailings storage facility. Up to several hundred gallons per minute (gpm) are produced by dewatering wells peripheral to the pit and from inflows to the pit; the average monthly rate of mine pit dewatering has varied over the past 20 years of mining from about 25 gpm to 900 gpm. The variability in mine pit inflow is primarily due to variability in bedrock fracture and fault conditions and seasonal variability in precipitation and groundwater recharge. Larger inflows would be expected when saturated bedrock fractures, joints or faults are first encountered, and after spring precipitation recharges the local bedrock aquifer.

2.2.3 Ore Processing and Water Balance

Ore Processing

Ore processing was described in the 1986 final EIS (DSL 1986). Ore from the mine pit is delivered to the mill, where it is crushed and ground to liberate the base metal bearing sulfides and precious metals. The sulfides are collected by a flotation process to produce zinc and lead concentrates containing precious metals that are shipped for further processing elsewhere. A gravity plant in the grinding circuit recovers coarse gold particles, which are further concentrated and refined into bullion bars and sold to precious metal refiners. **Figure 2.2-2** shows the process flow sheet. Remaining tailings are sent to the tailings storage facility.

A bulk flotation cyanide leaching circuit was initially permitted but abandoned in 1987, and a two-stage sequential flotation circuit was installed resulting in some changes to the processes. In particular, the use of cyanide compounds was limited, resulting in much lower residual cyanide concentrations in tailings water.

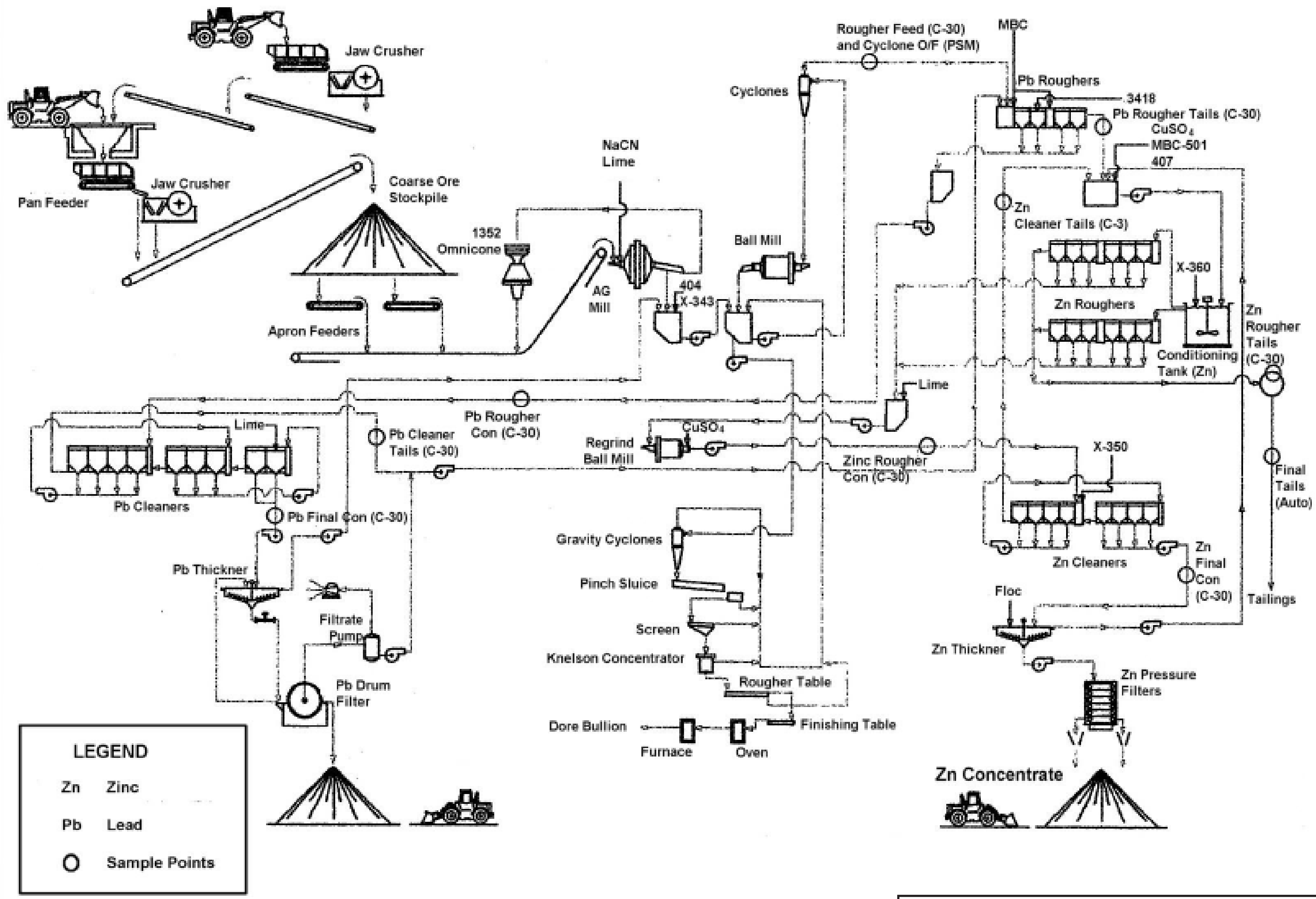


FIGURE 2.2-2
Process Flow Sheet

Montana Tunnels Project

Description of Reagents

Regulated chemicals are used as reagents for ore processing, maintenance, and operation of equipment and vehicles. The reagents permitted for use are xanthates, dithiophosphates, lime, copper sulfate, methyl isobutyl carbonol frother, dispersants, flocculants, sodium cyanide, zinc dust, lead nitrate, and diatomaceous earth (Montana Tunnels 2007). A detailed description of the type, amount, and other pertinent information is provided in the Montana Tunnels Operating Permit (Montana Tunnels 2007).

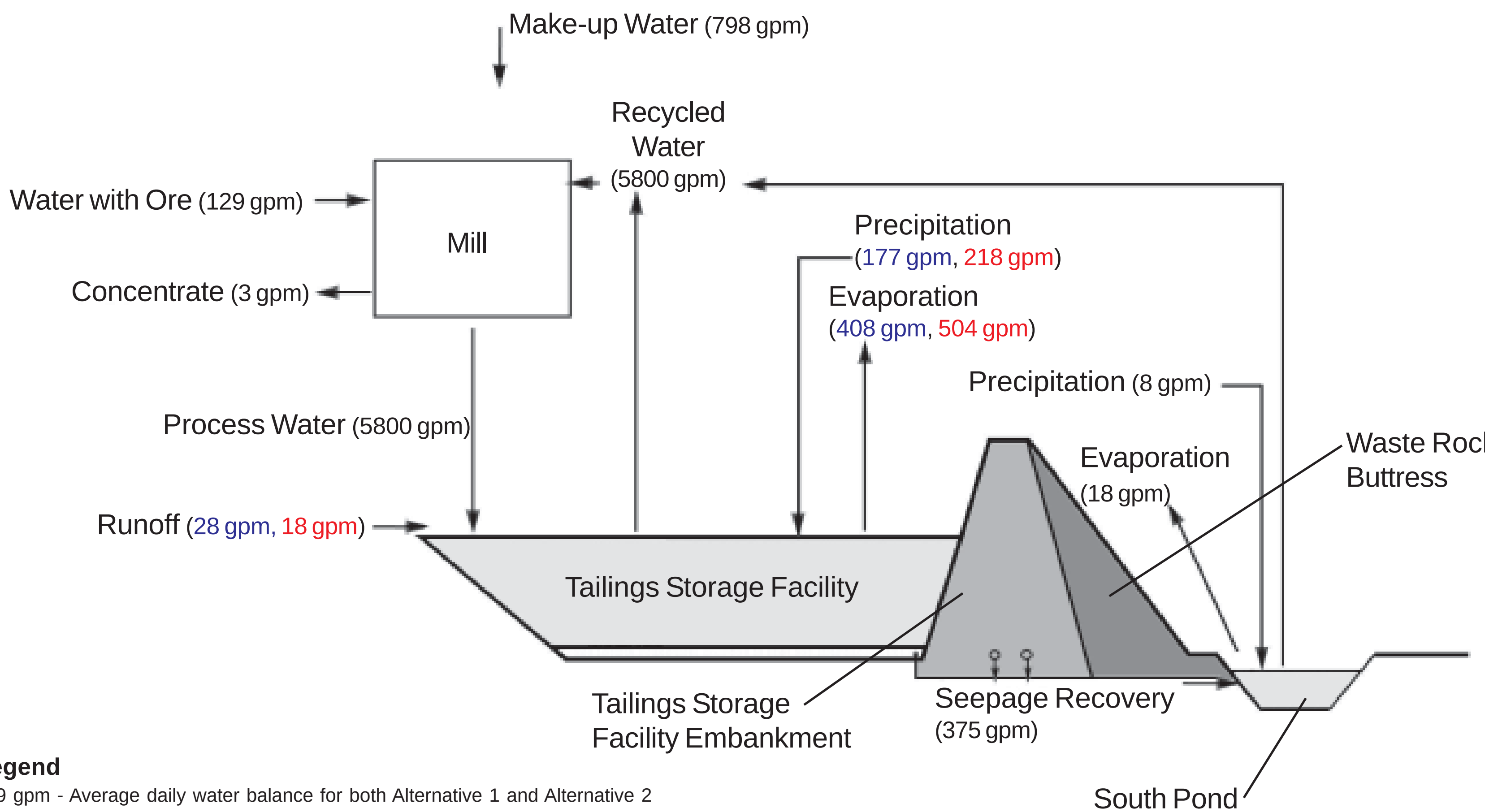
Water Balance

Montana Tunnels has a negative water balance, and water from on-site and external sources must be supplied to make up ongoing water losses to evaporation and entrainment in tailings solids. No water is discharged to surface water from the mine site. The overall average water balance for the mining and ore processing operations is provided in **Figure 2.2-3**.

Water is reclaimed from the tailings storage facility for reuse in the mill by means of a barge pump located at the facility. The barge pumps water to a head tank on a hill above the mill to supply feed water by gravity.

Sources of mill process water include: (1) tailings reclaim water, (2) pit dewatering wells, (3) direct precipitation and runoff, (4) moisture content of the processed ore, and (5) appropriations of surface water from Spring Creek, Prickly Pear Creek, and Clancy Creek. Supplemental makeup water is pumped to the south pond located downgradient of the tailings storage facility. The south pond receives water from on-site and off-site sources including: (1) tailings storage facility underdrain and embankment drain system (combined drains), (2) recovery well system, (3) Spring Creek, (4) Prickly Pear Creek, (5) Pen Yan Creek sedimentation pond overflow, and (6) direct precipitation and runoff. In addition, discharges from the Minah and Washington mines and localized surface water runoff are captured and recycled with the process water.

Other sources of water at the mine include a domestic water supply that provides clean water for human consumption and fire suppression. The domestic water is supplied from a groundwater well to a tank on a hillside east of the plant site. The domestic system produces up to 30 gpm of water.



Legend

129 gpm - Average daily water balance for both Alternative 1 and Alternative 2

28 gpm - Average daily water balance for Alternative 1 only (2004)

18 gpm - Average daily water balance for Alternative 2 only (2011)

Note:

Alternative 1 - No Action Alternative (L-Pit)
Alternative 2 - Proposed Action Alternative (M-Pit)

FIGURE 2.2-3
Average Water Balance
No Action Alternative (L-Pit) and
Proposed Action Alternative (M-Pit)

Montana Tunnels Project

Operational Water Resources Monitoring

Water samples are collected on a quarterly schedule; all data are summarized and reported to the agencies on a quarterly basis. Results are also evaluated in an annual comprehensive report provided to the agencies.

Recent surface water and groundwater monitoring locations, results, and data analyses are summarized in the 2006 Annual Water Resources Monitoring Report (Montana Tunnels 2007).

Surface Water Drainage

During the operational phase of the Montana Tunnels Project, drainage within or passing through disturbed areas would be controlled to avoid water quality problems. The objective of the drainage and diversion plan is to provide a drainage and diversion system that can be easily integrated into the final reclamation plan. Diversions that would convey storm runoff from the mine site are designed to carry runoff from the 100-year, 24-hour precipitation event.

Presently all stormwater runoff from mine site disturbance areas is captured within the mine's operating structures, including the mine pit, tailings storage facility, south pond, and the Pen Yan Creek sedimentation pond. This water is subsequently used as makeup water for the mill.

Montana Tunnels maintains a MPDES permit (# MT0028428) for the Pen Yan Creek sedimentation pond spillway should the pond overfill and discharge into the creek. This sedimentation pond structure diverts surface drainage and stormwater flows to the south pond through a decant standpipe system. The south pond is a storage pond and is clay lined to limit water losses to infiltration. Stormwater discharge is not expected during active mining operations, and Montana Tunnels has not discharged any water from the south pond during the past 20 years of mining.

2.2.4 Tailings Storage Facility

The tailings slurry stream is piped to the tailings storage facility from the mill following grinding and extraction of mineral values from the ore. The facility stores tailings and provides reclaim water for milling by way of barge pumps located in the east gully of the facility. Tailings are discharged along the north, west, and south edges of the tailings storage facility by a system of header lines with spigots. Coarse solids settle out first to form beaches, and the finer tailings fractions settle toward the center of the facility. Tailings are directly discharged to the central area of the facility during the summer and fall months to enhance settlement of the fine tailings. This practice

facilitates a more stable tailings mass suitable for reclamation after the completion of mining. The permitted tailings storage facility pond (tailings pond) area is 259.3 acres.

Tailings Storage Facility Embankment

The embankment has been incrementally permitted to the current elevation of 5,660 feet (Montana Tunnels 2007). The tailings storage facility embankment crest elevation at 5,660 feet is sufficient to contain all tailings volume and maintain contingency freeboard for Alternative 1.

The design of the embankment is adjusted based upon updated information obtained during operations and during each of the construction stages. Construction was adjusted from a downstream method to a modified centerline method in 1990. A design modification in 1994 included engineered adjustments to incrementally raise the ultimate embankment. The northwest waste rock storage area on the tailings storage facility, permitted in 1998, reduced the available tailings storage volume. Fill rock placed in the west notch area of the tailings storage facility to straighten the path of the tailings discharge line in 2002 also reduced available tailings volume. The development of additional ore reserves by pit highwall laybacks required an embankment raise amendment in 2002. Subsequent processing of low grade stockpiled ores during a mine closure period in 2005-2006 required an addition to the embankment to the currently permitted elevation of 5,660 feet to contain the ore remaining to be mined in the Alternative 1 (L-Pit) plan through 2009.

Construction of a waste rock buttress against the downstream slope of the tailings storage facility embankment began in 2002 to enhance embankment stability (permitted in March 1998 as Minor Revision 97-004). The first phase of the buttress was a compacted fill from the embankment base to the crest elevation. The waste rock buttress has been constructed to the crest elevation of the tailings storage facility embankment as each additional embankment lift is constructed. Montana Tunnels plans to place a minimum of 19.3 million cubic yards of waste rock to improve embankment stability. The waste rock buttress area has a total reserve capacity for up to 24.1 million cubic yards without changing the footprint. The location and configuration of the waste rock buttress are shown on **Figure 2.2-1**.

Seismic Design Parameters

Seismic design parameters are discussed in the revised Montana Tunnels Operating Plan, Revision 5, dated May 2007 (Montana Tunnels 2007). Updated seismic ground motion parameters have been adopted for the current embankment analyses at elevation 5,660 feet. Two levels of design earthquake are considered: the Operating Basis Earthquake (OBE) for normal operations and the Maximum Design Earthquake (MDE) for extreme conditions. Values of maximum ground acceleration and design

earthquake magnitude have been determined for both the OBE and MDE, as discussed below.

The OBE was taken as the 1-in-475-year return period event. This corresponds to a maximum firm ground acceleration of 0.15 gravitational constant. A design earthquake magnitude of 7.0 has been assigned to the OBE. The probability of exceedance for this event during the proposed 4-year operating period for the tailings storage facility expansion is approximately 1 percent.

The MDE for the tailings facility has been conservatively taken as equal to the Maximum Credible Earthquake with a magnitude of 7.5. The maximum firm ground acceleration for the MDE is 0.23 gravitational constant. The pseudo-static (seismic) analysis indicates that there would be no significant deformation of the embankment during an MDE. Post-liquefaction stability analysis shows that the static factor of safety is not reduced by liquefaction of the tailings. This indicates that the embankment would maintain stability regardless of the condition of the tailings, and that there is no potential for a flow slide or large deformation of the embankment following earthquake loading and liquefaction of the tailings.

Tailings Density

The current average dry density of the tailings within the tailings storage facility was determined to be 90 pounds per dry cubic foot in 2002 (Montana Tunnels 2007). Density has continued to increase since initial tailings deposition in the tailings storage facility in 1987. A wick drain program was initiated in 1993 to accelerate consolidation of the tailings slimes. Also, bulk tailings are distributed to the central area of the tailings storage facility using extended spigots in the ice free seasons to aid in compressing the finer tailings fraction. Projected density is estimated to be 95 pounds per dry cubic foot after closure assuming the fine slime tailings are consolidated. An average dry density of 105 pounds per dry cubic foot was assumed for the sandy tailings fraction, which is estimated at 40 percent of the total tailings. The change in tailings density allows more tailings to be stored within the permitted tailings storage facility area.

Wick Drain Program

Wick drains were installed in saturated slimes along the upstream face of the tailings storage facility embankment in 1993 (Montana Tunnels 2007). The wick drains were designed to enhance the stability of the ultimate embankment by improving vertical drainage within the structural tailings mass. Ongoing monitoring with piezometers indicates that the wick drains achieved the design objectives, expelling large quantities of water to the surface. Pore water removal was evidenced by ongoing degradation of

the ice cover throughout the winter months caused by upwelling of warmer water from the wicks.

An additional wick drain installation program is not required at closure as surface shaping and capping activities would be designed to compensate for ongoing settlement of the tailings surface.

Projected Pore Pressures

Pore pressures in the tailings are important for evaluating embankment safety. Higher pore pressures result in lower factors of safety. Pore pressures in the sandy beach materials are relatively low. The pore pressures in the slimes are typically much higher and are often at the total stress value, implying that the materials are completely saturated (Montana Tunnels 2007).

Long-Term Settlement of Tailings Surface

Ongoing consolidation of the tailings mass after closure could result in surface settlements, particularly where accumulations of low density tailings slimes would be thickest. The long-term settlement of the tailings surface is projected to be 10 to 20 feet after closure. The success of the 1993 wick drain program in enhancing consolidation within the tailings mass indicated that ongoing, large scale installations would improve tailings density, particularly in the slimes. In-situ tailings density and pore pressure measurements indicate that the tailings deposit is consolidating at a faster rate than anticipated in earlier studies (Montana Tunnels 2007). Selective tailings deposition would be used to fill in low areas in the pond prior to closure. Complete consolidation of the tailings mass is expected to take decades.

Tailings Storage Facility Water Quality

Ponded water on the tailings storage facility is continuously recirculated through the milling process with makeup water added to the circuit to replenish water lost to evaporation, entrainment in tailings solids, and seepage from the tailings storage facility. Tailings storage facility seepage water is collected by the combined drains, and recovery well system. Water from the combined drains and recovery well system reports to the south pond.

Twenty-two recovery wells were in place at the end of 2001. Seventeen of these wells were decommissioned in 2002 to construct the embankment waste rock buttress. Five recovery wells (GW-5, GW-8, GW-9, GW-10, GW-34) remain, and are also used for groundwater monitoring. The five recovery wells provide makeup water for the mill by pumping groundwater and tailings storage facility seepage at locations

downgradient of the south pond (pumping rate ranging from 50 to 80 gpm). Six new recovery wells were drilled to replace the decommissioned recovery wells, but do not produce large quantities of groundwater. Recovery wells GW-5, GW-8, GW-9, GW-10, and GW-34 would be pumped during the 5-year closure period and the extracted groundwater would be directed to the mine pit to aid initial pit flooding.

Tailings storage facility seepage water is hard, and exhibits elevated concentrations of sulfate, iron, cyanide, and manganese. Recent analysis of combined drain water indicates there are no concentrations of metals above DEQ-7 standards for human health (DEQ 2006a). A trace of cyanide, most of which is in a strongly complexed form, continues to be detected at low concentrations. **Table 2.2-2** provides recent comprehensive analysis of tailings storage facility seepage water quality from the combined drains compared to anticipated tailings leachate water quality presented in the 1986 final EIS. The concentrations of barium, iron, and copper were underestimated in the 1986 final EIS.

2.2.5 Waste Rock Storage Areas

Montana Tunnels projects that approximately 122.3 million cubic yards of waste rock would eventually be placed in the 425.9 acres of waste rock storage areas. The primary waste rock storage area is adjacent to the west side of the tailings storage facility. A waste rock buttress downstream of the tailings storage facility embankment improves the stability of the tailings storage facility. A 42-acre waste rock storage contingency area on the south side of Pen Yan Creek is permitted but not bonded and not included in disturbance acreage totals listed above. The need for contingency waste rock storage is not anticipated with the calculated volumes projected in the approved L-Pit mining plan.

The majority of the waste rock storage areas are permitted to have 2.5h:1v side slopes, although in some areas it is necessary to increase the steepness of the slopes to tie into original ground or minimize disturbance. Waste rock storage area slopes do not exceed 2h:1v in any situation.

Pen Yan Creek

The natural Pen Yan Creek channel is used to convey stormwater from waste rock storage area slopes and stormwater ditches to a sedimentation pond. Water from the sedimentation pond is conveyed to the south pond through a pipe system and used for water makeup in the milling process. Potential overflows from the sedimentation pond over a constructed spillway are regulated by MPDES permit MT0028428.

TABLE 2.2-2
NO ACTION ALTERNATIVE (L-PIT)
TAILINGS STORAGE FACILITY SEEPAGE WATER QUALITY

Parameter	Combined Drains Leachate Water Quality for Current Montana Tunnels Mine[a,b]	Anticipated Tailings Leachate Water Quality Presented in the 1986 Final EIS based on Information Provided in the 1984 Project Application
pH (s.u.)	7.09	ND
Alkalinity (mg/L as $CaCO_3$)	149	ND
Total Hardness (mg/L as $CaCO_3$)	658	ND
Arsenic (mg/L)	0.005	0.005
Barium (mg/L)	**0.031**	0.018
Cadmium (mg/L)	0.0004	0.0005
Chromium (mg/L)	NA	<0.005
Copper (mg/L)	**0.005**	0.002
Iron (mg/L)	**1.72**	0.22
Lead (mg/L)	<0.003	0.024
Manganese (mg/L)	4.5	ND[d]
Mercury (mg/L)	NA	<0.0002
Selenium (mg/L)	0.001	<0.002
Silver (mg/L)	<0.0005	0.002
Zinc (mg/L)	0.017	0.042
Cyanide, Total (mg/L)	0.015 – 0.042[c]	0.12 to 0.54

Notes:

Bold Indicates the concentration is greater than concentration presented in the 1986 final EIS (DSL 1986)

a Source of data: Montana Tunnels 2007.

b Concentrations do not exceed DEQ-7 human health standards.

c The use of cyanide in the mill circuit was greatly reduced in 1987 resulting in much lower concentrations of residual cyanide in the tailings leachate than presented in the 1986 FEIS.

d The FEIS states that "significant concentrations of manganese may also be expected" (page IV-11).

$CaCO_3$ Calcium carbonate

EIS Environmental Impact Statement

mg/L Milligrams per liter

NA In 1998, DEQ eliminated chromium and mercury from the parameter list because previous water quality data indicated these constituents were below or near laboratory detection limits.

ND No data are available for these constituents.

s.u. Standard units

The Pen Yan Creek drainage is permitted to be realigned to expand the waste rock storage area, but Montana Tunnels is not planning to do so under the approved L-Pit plan of operations.

Potentially Acid-Generating Material Handling

The waste rock storage plan ensures that potentially acid-generating waste rock (acid base potential less than 0 tons of $CaCO_3$ per 1,000 tons of waste rock) is covered by a layer of nonacid-generating material (acid base potential greater than 0 tons of lime per 1,000 tons of rock). This is accomplished by:

1) Placing waste with the potential to generate acid within the perimeter of a 100-foot-wide lift of nonacid-generating rock. Slope reduction is done within the nonacid-generating rock (**Figure 2.2-4)**.
2) Waste rock storage area tops that contain potentially acid-generating material would be covered with 36 inches of nonacid-generating cap rock from either the mine pit or from cap rock stockpiles. The cap rock will then be covered with 16 inches of soil**.**

3) In areas where it is not possible to construct the outer perimeter of the waste rock storage area with nonacid-generating material, the slope is reduced and then covered with 36 inches of nonacid-generating rock hauled either from the pit or from a cap rock stockpile. The cap rock will then be covered with 16 inches of soil**.**

Waste rock storage areas are built in approximately 50-foot lifts depending on access. In some areas, the lift height exceeds 50 feet to minimize disturbance. The base of each lift is set back to create benches. This minimizes the amount of material that must be moved to reduce the waste rock storage area slope during reclamation. Approximately every 100 feet in elevation, a wide bench is left for construction of a drainage ditch to minimize runoff and erosion on downgradient slopes. Unlined ditches are designed to pass a 100-year, 24-hour storm event, and the mine area drainage network is designed to conform to the post-mining topography and drainage plan (**Figure 2.2-5**). Final details of the design of all diversions and channels would be completed at the end of the mining operation. Use of riprap or other channel protection would be determined at that time and would be based on channel performance during the mining operation and functioning of the drainage and diversion system during post-closure (Montana Tunnels 2007).

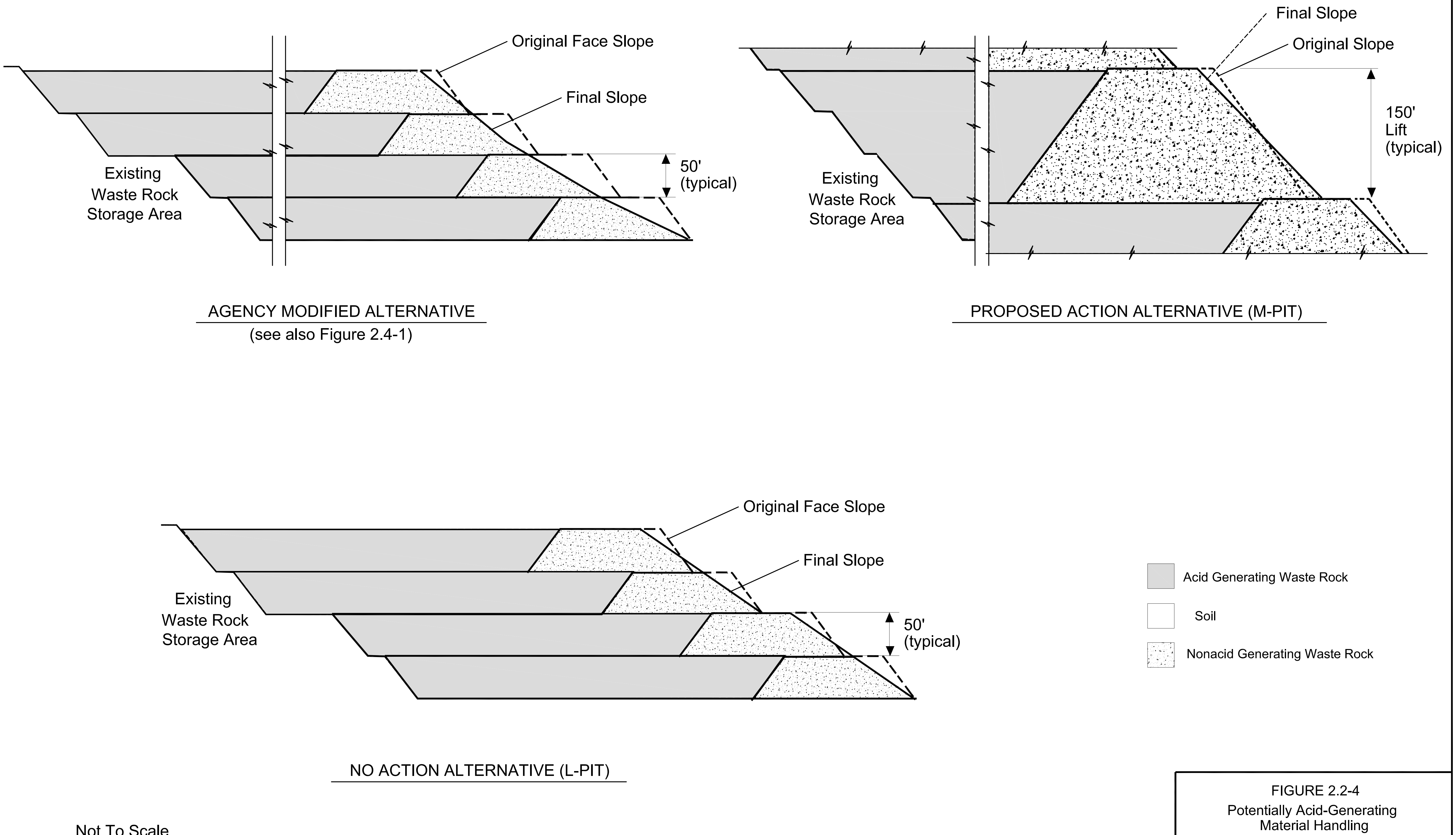


FIGURE 2.2-4
Potentially Acid-Generating Material Handling

Montana Tunnels Project

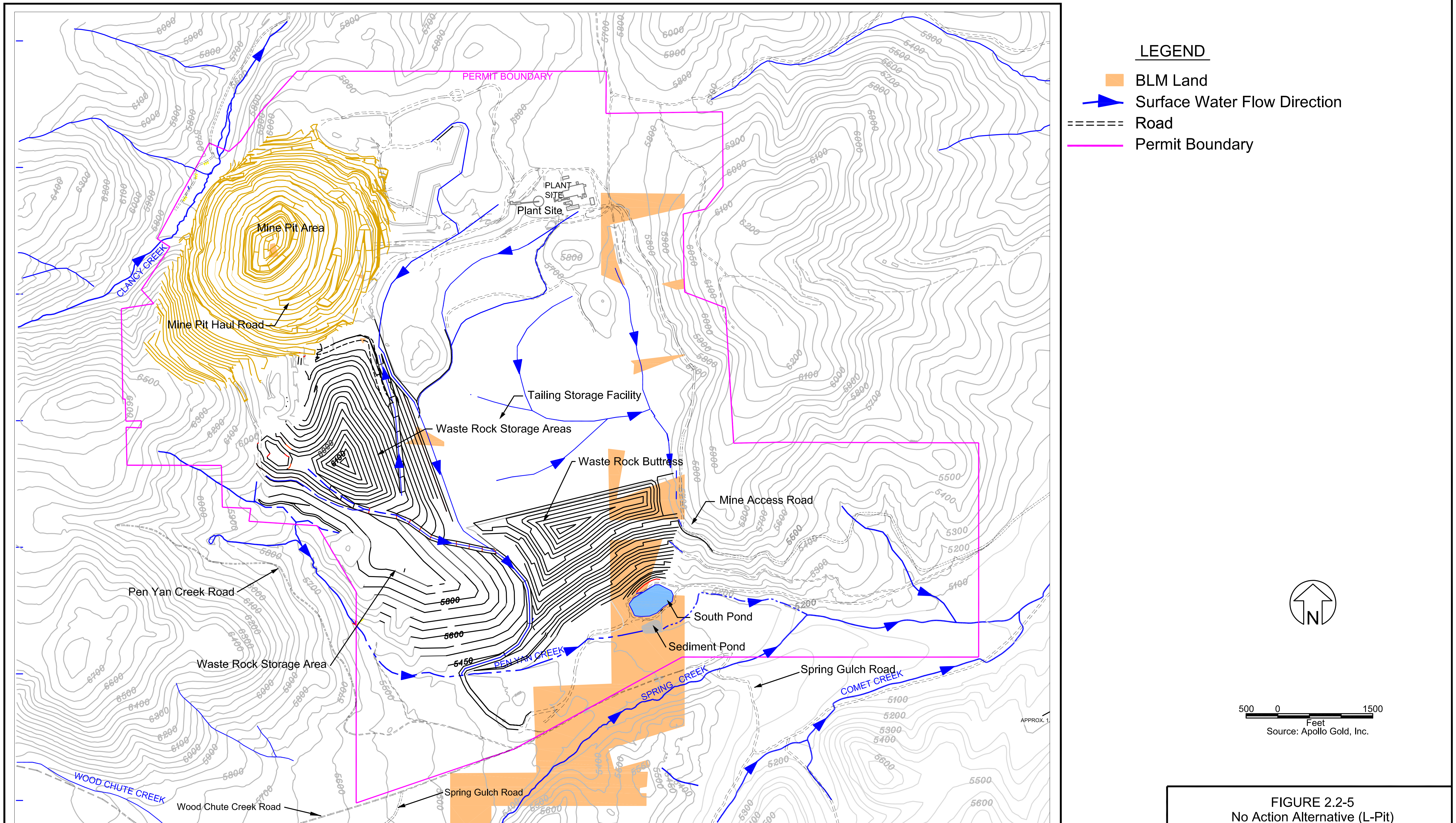


FIGURE 2.2-5
No Action Alternative (L-Pit)
Post-Mining Topography and
Drainage Plan

Montana Tunnels Project

2.2.6 Roads and Miscellaneous Areas

Main Access Road

The main access road is 2.6 miles long from the Wickes county road to the mine site, running west and then north around the side of Alta Mountain. The access road would remain at closure. The road presently meets county road specifications.

Spring Gulch Road

The 1986 final EIS and the Operating Permit discuss the potential for the Spring Gulch Road to be covered with waste rock. Although permitted, this aspect of the operating permit was not implemented, and Montana Tunnels does not now intend to cover the road. Relocation and/or reconstruction would not be required.

Miscellaneous Other Operational Roads

The location of the pit ramp haul road changes periodically to meet operational needs for access and safety in the mine. A 90-foot-wide pit haul road, with a grade of up to 12 percent, accesses the pit on the east side at the 5,650-foot elevation, switching back on north to south headings. The haul roads from the mine to the waste rock storage areas and the ore stockpiles vary in width from 40 to 90 feet, with a maximum grade of 8 percent.

Miscellaneous other disturbance covers 30.9 acres, which includes miscellaneous service roads, power lines, and small structures on the mine site plus other off-site facilities, such as water pump stations, air monitoring systems, and the railroad concentrate load-out facility east of Helena.

2.2.7 Cap Rock, Soil, and Gravel Stockpiles

Cap Rock

Cap rock is considered to be non-sulfide waste rock generally obtained from the overburden in the upper highwalls of the mine (**Table 2.2-3**). This material consists of Elkhorn Volcanics, Lowland Creek Volcanics, and non-mineralized dike rock (See the geology section in Chapter 3 for more details). Mined cap rock is stored in stockpiles to be used as reclamation cover material. There are currently over 5 million cubic yards of excess cap rock stockpiled at the mine. If cap rock stockpiles are not completely used, the stockpiles would be graded during reclamation to match existing topography. The area would be covered with soil and reseeded in a manner consistent with the mine’s reclamation plan for waste rock storage areas.

TABLE 2.2-3 CHARACTERISTICS OF CAP ROCK				
Material Class	**Gold Equivalent**	**Lead Conc.**	**Zinc Conc.**	**Acid Base Potential**
Ore	+0.016 oz/ton	NA	NA	<0 tons of $CaCO_3$ per 1,000 tons of waste rock
Low Grade Ore	0.014 - 0.016 oz/ton	NA	NA	<0 tons of $CaCO_3$ per 1,000 tons of waste rock
Acid Waste	NA	>0.05%	>0.10%	<0 tons of $CaCO_3$ per 1,000 tons of waste rock
Non-Acid Waste	NA	<0.05%	<0.10%	>0 tons of $CaCO_3$ per 1,000 tons of waste rock

Notes:
$CaCO_3$ Calcium carbonate
Conc. Concentration
NA = Not applicable
Oz/ton = Ounces per ton
< Less than
> Greater than

Soil and Gravel

Soil and gravel stockpiles are permitted to cover 59.6 acres of disturbance (**Figure 2.2-1**). The soil balance is dynamic and changes yearly due to ongoing surface disturbance and waste rock storage area reclamation. Montana Tunnels projects that at the end of mining a surplus of over 180,000 cubic yards of soil would be available for reclamation.

The gravel pit disturbance area is 33.1 acres (**Figure 2.2-1**). Gravel is crushed and screened as needed to provide construction materials for mining operations. Piles of crushed material are staged in the gravel pit disturbance area until used.

2.2.8 Reclamation Objectives and Schedule

The objectives of reclamation are to stabilize disturbed areas as soon as practical during the operational phase. The final reclamation objective is to complete reclamation of all disturbed areas and return the land to useful productivity. Specific reclamation objectives are:

1. Restore the land for livestock grazing and wildlife grazing and habitat.
2. Provide permanent protection for the area’s air, surface water, and groundwater resources.

3. Restore the area for public recreation, including removal of public hazards.

Most post-mining land uses would essentially be the same as pre-mining uses.

Reclamation would be completed concurrently with operations as disturbed areas become available. Waste rock storage areas would be regraded and reclaimed from the bottom toward the top as the storage areas are constructed in 50-foot lifts.

Reclamation Schedule

A 5-year closure period is planned to reclaim all areas disturbed by mining activities. A post-closure period is also planned for monitoring and maintenance. Approximately 30 percent of areas disturbed by mining will have been reclaimed by concurrent reclamation prior to closure. Reclamation of all remaining facilities would commence at the conclusion of mining operations. Closure of the tailings storage facility surface would require a 5-year period to allow time for sufficient dewatering and settlement of tailings solids.

The waste rock storage areas are reclaimed incrementally as lifts are completed. Any reclamation of waste rock storage areas that cannot be completed concurrently with mining would be completed after closure. Montana Tunnels would provide DEQ and BLM with an annual report describing the comprehensive status of the operation, including the progress of concurrent reclamation and any future plans for concurrent reclamation.

Reclamation of the tailings storage facility would begin at the conclusion of milling operations and last for 5 years as described above.

The facilities area, soil stockpile sites, roads and sediment control structures would be graded to the natural contours at the conclusion of operations. Montana Tunnels plans to donate some buildings and property at the mine site (including the mill, warehouse, and administration buildings, as discussed in Section 1-2) to the Jefferson Local Development Corporation. All other buildings and structures would be demolished and removed when they are no longer needed. Some infrastructure may be used for maintenance and equipment needs for 5 or more years after mining ceases.

2.2.9 Topography after Mining and Reclamation

Disturbed areas would be graded to blend with undisturbed topography. Grading would generally be conducted with track dozers. **Figure 2.2-5** shows proposed contours after reclamation.

Pit Reclamation

Reclamation of the mine pit would leave highwalls as rock faces. At closure, most of the mine dewatering system would be shut off, and the L-Pit would begin to fill with water. Because of stability problems in the northwest highwall of the pit, vertical pumping wells would be maintained on the north, northwest, and southwest highwalls for 5 years during closure to provide factors of safety of at least 1.2 during the early stages of mine pit flooding. The L-Pit would remain accessible above the water level by way of the pit access ramp. Montana Tunnels' plan is to allow the pit highwalls to naturally weather and ravel into the pit, cover pit benches, and form talus slopes above the pit lake.

Montana Tunnels would revegetate the pit perimeter and conduct weed control. The pit would be fenced and signed.

Pit Inflow Sources

During the 5-year closure period, the following sources of water would likely contribute to pit water inflow; and formation of a post-mining pit lake:

- Groundwater inflow,
- Tailings storage facility surface runoff,
- Seepage from the tailings storage facility combined drains,
- Groundwater pumped from the recovery well system,
- Water stored in the south pond, and
- Runoff from the catchment area around the pit and the pit highwall.

The total pit surface water catchment area including the area of the mine pit and surrounding natural and reclaimed surfaces would be approximately 241 acres.

After the 5-year closure period, Montana Tunnels would cease pumping water from the south pond to the pit. The reclaimed tailings storage facility would be designed to route surface water runoff across the tailings storage facility surface to the embankment spillway and then finally to a percolation pond to be constructed in the reclaimed south pond.

South Pond

The south pond would be used to collect tailings storage facility seepage water and recovery well system discharge during the 5-year closure period (**Figure 2.2-1**). The water in the south pond would be pumped to the pit to accelerate formation of a post-mining pit lake. After the 5-year closure period, the pond would be reclaimed and converted to a percolation pond to manage the remaining seepage water and surface water runoff from the reclaimed tailings storage facility.

Tailings Storage Facility Reclamation

The final surface of the tailings storage facility would have a 0.5 to 5 percent slope to the east toward the spillway (**Figure 2.2-5).** Drainage ditches would be constructed to channel stormwater toward the spillway channel. To prevent surface erosion and limit infiltration, Montana Tunnels would construct channels with synthetic liners across the tailings storage facility surface.

When the milling process ends, dewatering of the tailings storage facility would begin. The ponded water on the tailings storage facility surface would be removed during the first years following cessation of mining. Portable pumps would be used to remove the ponded water from the tailings storage facility as needed. Ponded water would be pumped to the mine pit during the 5-year closure period. Construction of water runoff controls on the tailings storage facility surface would occur when adequate consolidation of the tailings has taken place.

Dust control would be provided during reclamation of tailings by progressively capping the sandy beach areas of the facility following removal of the pond. Water spigotting or sprays would be used, if necessary, to control dust on exposed surfaces of the tailings storage facility.

The anticipated consolidation of tailings would leave a natural low point in the southeast corner of the tailings storage facility. Using fill and grading, the tailings surface would be sloped to promote drainage to the spillway at the east end of the tailings storage facility embankment. Surface runoff after the 5-year closure period would report to a percolation pond constructed in the reclaimed south pond.

The tailings surface would be capped with 36 inches of nonacid-generating rock and covered with an additional 24 inches of soil which would then be seeded to minimize water infiltration and to complete final reclamation. More soil would need to be placed if additional settlement occurred after soil placement. After soil application, the tailings surface area would be amended with fertilizer and plowed to loosen the soil. The tailings surface would then be drill seeded with a grasslands seed mixture. Runon

control ditches upgradient of the tailings storage facility surface would divert water away from the facility.

A spillway would be constructed on the east end of the tailings storage facility embankment as part of the closure activities to route stormwater off the tailings storage facility surface and minimize flows into the tailings. The spillway is designed to pass the probable maximum precipitation event to a percolation basin constructed in the former south pond.

Water flows from the spillway would be directed into a bedrock chute to the percolation pond. The clay liner of the south pond would be excavated during the closure period to expose native porous colluvial materials and create a percolation basin. Large rip rap would be placed in the bottom of the basin and at the spillway outlet to dissipate flow energy.

Reclamation of the waste rock storage area that buttresses the downstream face of the tailings storage facility embankment would be the same as other waste rock storage area reclamation. Slopes would be reduced to a 2.5h:1v. The top of the tailings storage facility embankment and the buttress slope would be covered with 16 inches of soil and seeded.

Tailings Storage Facility Seepage

Seepage from the tailings storage facility is controlled by an underdrain constructed using a bentonite amended soil liner, by an embankment drain, and a recovery well system located downgradient of the tailings storage facility embankment and south pond. The south pond receives water from on-site and off-site sources, including the recovery well system and the combined drains.

After cessation of mining, the south pond would be used to capture stormwater and seepage water coming from the tailings combined drains during the 5-year closure period. This water would be pumped into the mine pit to accelerate pit lake formation. The recovery well system would continue to operate and pump water to the south pond during the 5-year closure period.

Waste Rock Storage Areas

During reclamation, waste rock storage area slopes would be graded to a final slope of 2.5h:1v to enhance vegetation success and reduce erosion potential. Tops of waste rock storage areas would be essentially flat with less than 2 percent slopes. Waste rock storage area tops would be graded to eliminate depressions and to provide surface water flow away from the steeper side slopes.

Three feet of cap rock would be spread over waste rock storage area tops or slopes if chemical testing indicates that the surface materials have acid-generating potential (acid base potential less than 0 tons of $CaCO_3$ per 1,000 tons of waste rock); the cap rock would not be added to slopes that did not exhibit acid-generating potential (acid base potential greater than 0 tons of lime per 1,000 tons of rock). Sixteen inches of soil would be spread on all surfaces, regardless of whether the cap rock had been added or not. The surfaces would then be revegetated to minimize infiltration.

Shallow drainageways would be created on the waste rock storage area tops to direct flows to drainage channels (**Figure 2.2-5**). Diversions would be located along the uphill edge of the waste rock storage areas to reduce runon water to the waste rock storage areas. The general plan of the surface water drainage diversion at the end of the 5-year closure period is shown on **Figure 2.2-5.**

Waste rock storage areas would be built in 50-foot lifts with a wide bench every 100 feet of elevation to accommodate a drainage ditch (**Figure 2.2-4**). The drainage ditches would be sized for the 100-year, 24-hour storm event. Stormwater runoff from the main waste rock storage area would flow into the Pen Yan Creek drainage by way of ditches constructed on the top and slopes and along the base of the waste rock storage area. During the closure period, stormwater runoff from the waste rock storage area slopes and the gravel pit area would be routed to the Pen Yan Creek sedimentation pond and subsequently to the south pond by way of a standpipe overflow structure. The Pen Yan Creek sedimentation pond would be removed at the end of the closure period. A connecting stream channel would be constructed to the original Pen Yan Creek drainage channel (**Figure 2.2-5)**.

Miscellaneous Areas and Roads

The facilities area, soil stockpile sites, miscellaneous roads, and sediment control structures would be graded to the natural contours at the conclusion of the operation as shown on **Figure 2.2-5**. The 2.6-mile access road would remain at closure. The road presently meets county road specifications. The service road to the waste rock storage area would be reclaimed as a drainage channel as part of the waste rock storage area drainage system. The upper south pit ramp would be reclaimed by pulling back the bank or using fill as necessary to bring this area back to natural slope. Flat roads would be ripped before soil and seed are applied. The pit ramp would be reclaimed from the pit rim to the modeled high water mark of the pit lake at closure.

The mill structure, warehouse and administration buildings would be cleaned out and transferred to the Jefferson Local Development Corporation following closure. All other building and structures including stockpile cover, conveyors, crusher buildings, substation, truck shop, garage, lube-bay, and tanks would be removed by salvage

companies when they are no longer needed. Some infrastructure may be used for 5 or more years for maintenance and equipment needs.

2.2.10 Revegetation

The revegetation plan has been developed to stabilize disturbed areas by controlling erosion and sedimentation to meet post-mining land use objectives. The reestablishment of vegetation types that are ecologically similar to those described for the area would aid in the restoration of aesthetic, recreational, wildlife, and livestock grazing values.

Montana Tunnels would establish four post-mining vegetation types: grassland, shrub/grassland, Douglas-fir, and aspen. The selection of these types was based on the acreage of each type to be disturbed and site factors following mining, including steepness of slope, aspect, soil characteristics, topography, and post-mining land use objectives.

Species Selection

Selection of plant species suitable for revegetation has been and would continue to be based on a variety of parameters, including pre-mining abundance (**Table 2.2-4**), the type and acreage of vegetation anticipated to be disturbed in the 1986 final EIS (**Table 2.2-5**), establishment potential, growth characteristics, soil stabilizing qualities, palatability, availability, and land use after mining. Species selection would continue to be also based on redistributed soil and substrate properties, including texture, coarse fragment content, water holding capacity, permeability, erosion hazard, and trace element concentration.

Seed would be obtained from local seed companies. Seed purity, adaptability, and viability would be optimized. Montana Tunnels would reevaluate each proposed mixture prior to seeding and, with DEQ and BLM concurrence, modify the mixture to reflect species availability, site differences, and changes in reclamation technology.

2.2.11 Post-closure Monitoring and Disposal Plans

Post-closure Water Resource Monitoring

The water quality monitoring program described below would not be static or inflexible. The program would remain flexible enough to respond to data trends, changes in informational requirements and site specific situations.

TABLE 2.2-4
IMPORTANT PLANT SPECIES BY COMMUNITY

Community	Grasslike	Forbs	Shrubs/Trees
Grassland	Idaho fescue Rough fescue Kentucky bluegrass Bluebunch wheatgrass Prairie junegrass Timber oatgrass Needleleaf sedge	Silky lupine Sulfur buckwheat Ballhead sandwort Rose pussytoes Prairiesmoke Moss phlox Tufted fleabane Horse cinquefoil Missouri goldenrod Common yarrow Fernleaf fleabane Sticky geranium	
Shrub/grassland	Timber oatgrass Bluebunch wheatgrass Idaho fescue Rough fescue Prairie junegrass Kentucky bluegrass Needle-and-thread	Rose pussytoes Cudweed sagewort Sulfur buckwheat Sticky geranium Dalmatian toadflax Missouri goldenrod Fringed sagewort	Big sagebrush Antelope bitterbrush Woods' rose
Douglas-fir	Pinegrass Kentucky bluegrass Bluebunch wheatgrass Elk sedge Idaho fescue Rough fescue	Arrowleaf balsamroot	Antelope bitterbrush Lodgepole pine Douglas-fir
Quaking aspen	Pinegrass Kentucky bluegrass	Creeping white prairie aster Northern bedstraw Mountain sweetroot Veiny meadowrue Sticky geranium	Oregon grape Chokecherry Woods' rose Red raspberry Quaking aspen Douglas-fir

Source: Montana Tunnels 2007

TABLE 2.2-5 DISTURBANCE ACREAGES BY HABITAT TYPE [a] (MONTANA TUNNELS STUDY AREA, JEFFERSON COUNTY MONTANA, 1984)	
GRASSLAND	**DISTURBANCE ACREAGE**
Idaho fescue/bluebunch wheatgrass	283
Rough fescue/bluebunch wheatgrass	170
Rough fescue/Idaho fescue	46
SHRUB/GRASSLAND	
Big sagebrush/Idaho fescue	10
Bitterbrush/rough fescue	62
Rose	1
DOUGLAS-FIR	
Douglas-fir/Idaho fescue	32
Douglas-fir/rough fescue	123
Douglas-fir/elk sedge	20
Douglas-fir/pinegrass	119
QUAKING ASPEN	21
DISTURBED	33
CROPLAND	45
TOTAL	965

Source: Montana Tunnels Reclamation Plan, February 20, 1986, Revision 3, Table III-10

[a] Acreage based on areas of disturbance anticipated in the final EIS (DSL 1986)

During the 5-year closure period, a minimum of 14 compliance wells and several surface water sites would be sampled quarterly. Additional water samples would be taken from the flooding mine pit. Sample results from closure period monitor locations would be evaluated and, based on findings and approval from DEQ and BLM, the monitoring frequencies and lists of measured parameters could be reduced over time. Sampling in the flooding pit lake would continue at different depths during the post-closure period.

Surface Water

To ensure that surface water runoff after closure meets the reclamation objectives, the post-closure monitoring program would be a continuation of the surface water monitoring program conducted during the operational phase of the mine amended as necessary. A final surface water monitoring program would be developed and submitted to DEQ and BLM for their review and approval prior to its implementation.

Groundwater

Upon completion of mining, a groundwater monitoring program would be implemented to document groundwater quality. The major interest in the groundwater system after closure would be the long-term influence of the tailings storage facility, waste rock storage areas, and the mine pit. Monitoring locations that were used for operational monitoring would be used in the reclamation monitoring evaluations after closure.

The groundwater monitoring program after closure would concentrate on the following areas:

1. Downgradient of the tailings storage facility.
2. Peripheral to and downgradient of the waste rock storage areas—particularly in the Wood Chute Flats area.

Tailings Storage Facility Stability Monitoring

Structural performance of the tailings storage facility embankment would be monitored after mining and ore processing have been completed. Stability monitoring would involve a continuation of piezometer readings within the embankment, monitoring of flows from the embankment drain system, and monitoring of tailings settlement during the closure and post-closure periods.

Solid Waste Disposal

After removal and salvage of buildings not left for Jefferson Local Development Corporation use, pipelines, equipment, and facilities, any remaining solid waste would be disposed in accordance with all applicable laws and regulations. Inert waste (concrete, plastic, steel, wood, etc.) may be buried in on-site waste disposal areas. Any regulated materials or hazardous waste present in the mining or ore processing areas would be properly disposed, marketed, recycled, or returned to vendors in accordance with regulations. Standard municipal wastes would be taken to the Lewis and Clark County landfill in truck roll-off dumpsters.

2.3 Alternative 2 - Proposed Action Alternative (M-Pit)

Development drilling programs at Montana Tunnels have delineated additional ore that extends beneath the existing mine pit in the pipe of an ancient volcano. The ore body provides a large reserve for mining and milling beyond the current plan of operations. Montana Tunnels proposes to extend its life-of-mine plan to access this M-Pit ore reserve by open pit mining methods as described in the application for permit amendment to Operating Permit 00113 (Montana Tunnels 2007). The added ore reserve would lengthen mining and milling operational life by almost 5 years into 2013. The overall life of mine would be 27 years. To ensure an uninterrupted supply of ore to the mill between the current plan and the M-Pit Mine Expansion Plan, overburden stripping from the mine pit highwall layback must begin in 2009.

Proposed changes to the current Operating Permit include (1) increasing the permitted area and depth of the mine pit; (2) expanding waste rock storage areas; (3) raising the tailings storage facility embankment for additional tailings storage; (4) providing staging areas for soil and gravel; (5) diverting the courses of two stream channels; (6) rerouting a portion of the mine access road around the tailings storage facility; and (7) routing a portion of the flow from Clancy Creek into the mine pit.

Ore handling and processing facilities would continue to operate as currently permitted. Reclamation of disturbance areas would be consistent with permitted specifications and methods. Some changes to the reclamation plan are proposed for the management of water to accelerate flooding of the mine pit to form a pit lake after mining is completed. Changes in disturbance are discussed in Section 2.3.1.

2.3.1 Permit Boundary and Disturbed Areas Description

The permit boundary around the mine area would be expanded by 269.8 acres to encompass three new disturbance areas **(Table 2.3-1)**. Areas changing include the mine pit in the Clancy Creek drainage for mine expansion and wetlands replacement, the contingency waste rock storage area on the west side of the mine, and an area for the planned relocation of Pen Yan Creek. All extensions of the permit boundary are on land owned by Montana Tunnels.

TABLE 2.3-1 NO ACTION (L-PIT) AND PROPOSED ACTION (M-PIT) PERMIT AREA COMPARISON	
Current Permit Area (Acres)	2,116.0
Proposed Permit Area (Acres)	2,385.8
Net Change in Permit Area (Acres)	269.8

The total proposed disturbed areas would increase 252.7 acres from 1,199.5 acres to 1,452.2 acres (**Figure 2.3-1**). An overlap of an additional waste rock storage area on existing waste rock storage areas would result in the redisturbance of 147.1 acres of previously reclaimed waste rock storage area slopes and tops. **Table 2.3-2** illustrates the current permitted disturbance by area and the changes that would result from the Proposed Action. **Figure 2.3-1** shows the proposed general arrangement of mine features. Several additional contingency areas are also identified in the Proposed Action to provide extended waste rock storage areas and potential soil salvage areas, if required for final reclamation.

Changes in waste rock storage area disturbance are due to expansion of the south and west waste rock storage areas (**Figure 2.3-1**). The new disturbance acres listed in **Table 2.3-2** includes 40.5 contingency acres that would likely not be used. Cap rock and low grade stockpile disturbance area changes are due to fewer acres used for low grade stockpiles, but increases in the other waste rock storage areas.

Changes in the south pond and associated ponds and tailings storage facility embankment crest acres are due to a stormwater drainage channel directed toward the mine pit instead of over a spillway, and then to the south pond. Embankment crest and the tailings storage facility acreage would increase due to additional tailings storage capacity.

The mine pit acres would increase due to the pit layback. The acres designated as pit perimeter would decrease because pit expansion would use those acres (**Figure 2.2-2**).

The acres used for facilities would not change, but some buildings including the mill, warehouse and office buildings, laboratory and two outside storage buildings would be donated to the Jefferson Local Development Corporation for business development. The remaining structures, stockpile cover, conveyors, crusher buildings, substation, truck shop, garage, lube-bay, and tanks would be removed by salvage companies.

In the initial phase of mining, Montana Tunnels would stockpile enough gravel to last the duration of the project. The gravel pit area would then be covered by the waste rock storage area expansion. A soil surplus is anticipated, so 51.7 acres classified as "new disturbance" are contingency soil salvage areas that would not likely be used.

Other road and miscellaneous increases in acreage are due to changes in the mine access road, Pen Yan Creek realignment, and Clancy Creek wetlands development.

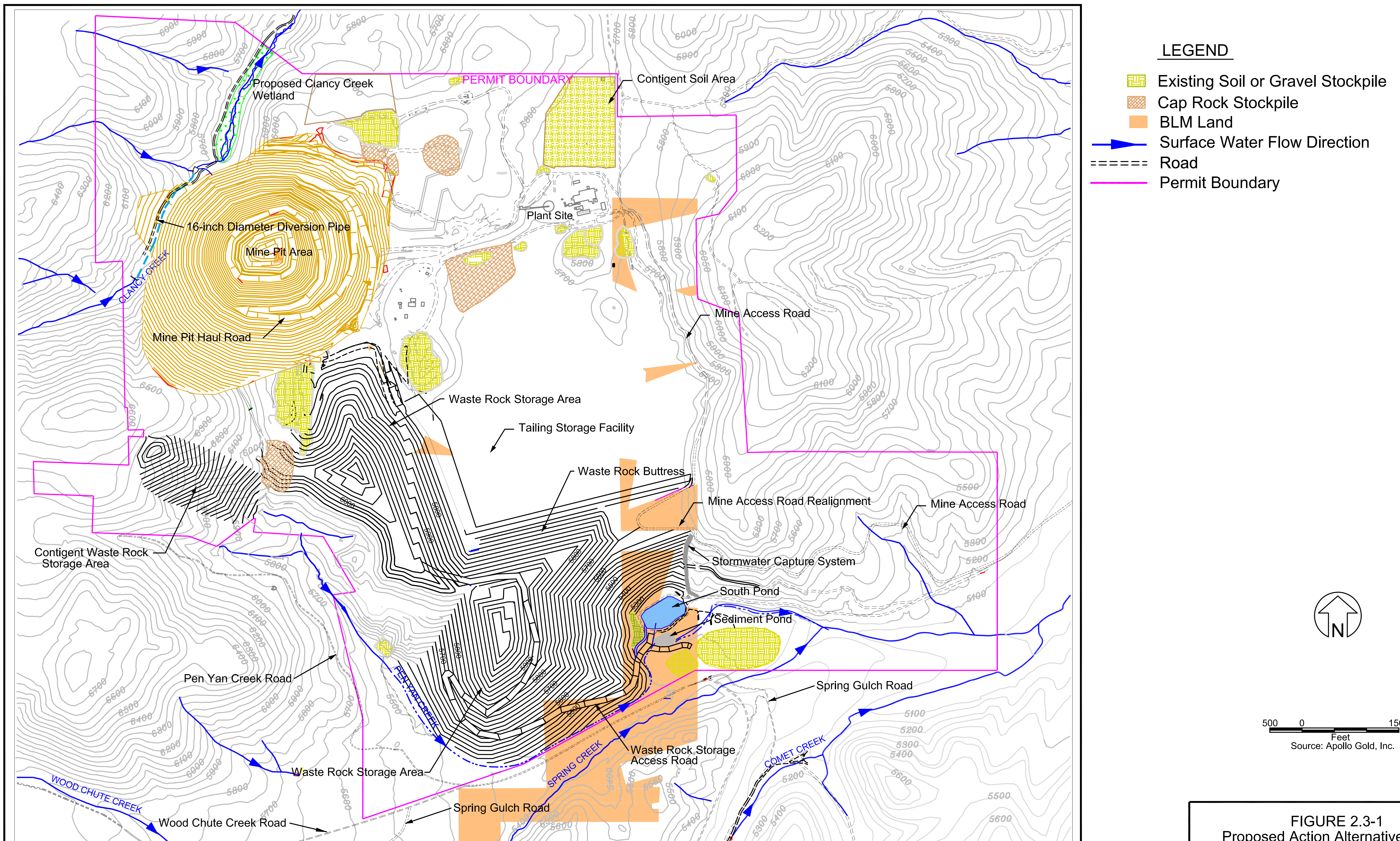


FIGURE 2.3-1
Proposed Action Alternative (M-Pit)
Mine Features at Cessation of Mining

Montana Tunnels Project

TABLE 2.3-2 DISTURBANCE AREA SUMMARY					
Area	**Currently Permitted L-Pit Alternative 1 Oct. 2006 (Acres)**	**Proposed M-Pit Mine Expansion Alternative 2 (Acres)**	**Net Area Change (Acres)**	**New Disturbance Area (Acres)**	**Redisturbance Area (Acres)**
Waste Rock Storage Areas	425.9	579.1	153.2	101	123.7
Cap Rock and Low Grade Stockpiles	66	68.3	2.3	0	0
South Pond, Water Retention Ponds and Tailings Dam Top	22.7	24.7	2.0	3.5	0
Tailings Storage Facility	259.3	272.6	13.3	14.4	0
Mine Pit	248.4	287.7	39.3	35.1	0
Mine Pit Perimeter	16.0	11.1	-4.9	0	0
Facilities	37.6	37.6	0.0	0	0
Gravel Pit Area	33.1	0.0	-33.1	0	0
Soil and Gravel Stockpiles	59.6	115.3	55.7	70.7	0
Roads and Miscellaneous	30.9	55.8	24.9	18.8	0
TOTAL	**1,199.5**	**1,452.2**	**252.7**	**243.5**	**123.7**

BLM Land

BLM land (131.8 acres) is contained within the Operating Permit boundary. The proposed expansions of the permit area are all on land owned by Montana Tunnels and would not incorporate additional BLM land within the adjusted perimeter. Expansion of the footprint of the main waste rock storage area, realignment of the access road, and new gravel and soil stockpile locations would increase disturbed BLM land from 56.7 acres in Alternative 1 to 83.1 acres in Alternative 2 (see **Figure 2.3-1**).

2.3.2 Mining Method and Mine Pit Description

Open pit mining practices and mine pit design for the M-Pit Mine Expansion would remain the same as current operations. The mine pit for Alternative 2 would increase to 287.7 acres to access deeper ore reserves. The mine pit increase includes disturbance associated with excavation and removal of 1,800 linear feet of the existing Clancy Creek channel and associated wetlands, and a diversion of Clancy Creek around the northwest side of the pit rim (**Figure 2.3-2**). The maximum elevation of the mine pit disturbance would be on the south side of the mine at 6,450 feet. The pit bottom would be deepened from the 4,250-foot elevation to the 4,050-foot elevation. Approximately 46.3 million cubic yards of waste rock and 28 million tons of tailings would be generated under Alternative 2. An estimated 24 to 28 million additional tons of ore would be removed under Alternative 2.

2.3.3 Ore Processing and Water Balance

Ore Processing

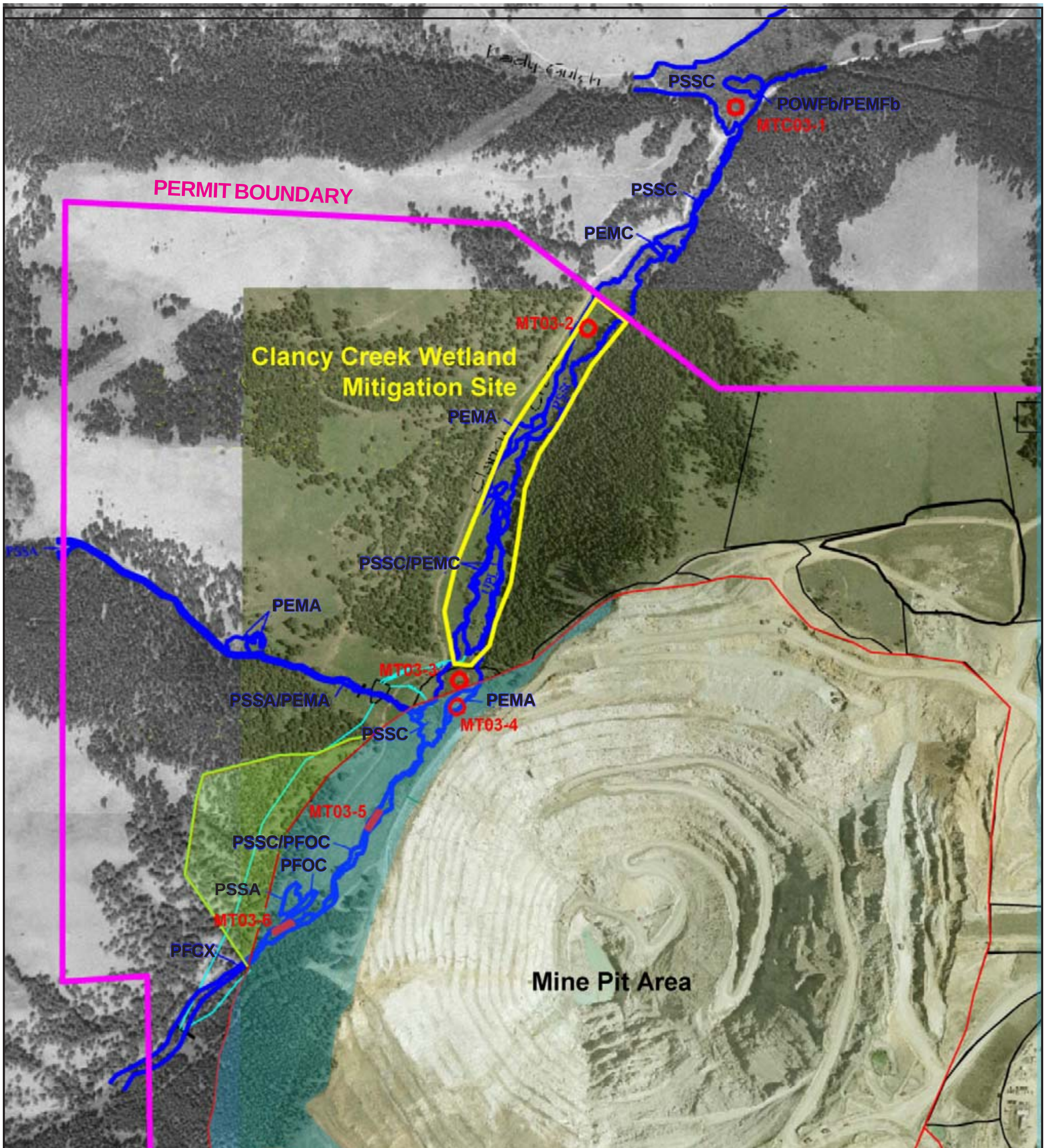
Under Alternative 2, M-Pit ore would continue to be mined from the mine pit and transported to the mill. Between 24 and 28 million tons of ore could be mined in addition to the 102 million tons permitted in the present mine plan. The ore would be crushed and ground to recover metals, which would be concentrated using flotation, as is described in Alternative 1. Tailings would be pumped to the tailings storage facility.

Description of Reagents

The same classes of reagents would be used as described for Alternative 1.

Water Balance

Montana Tunnels would continue to operate at a negative water balance but specific components would change because of the increased size of mine features (*e.g.*, the tailings pond). The Alternative 2 operational water balance is illustrated in **Figure 2.2-3.**



PERMIT BOUNDARY
WETLAND PLOT
WETLAND BOUNDARY
CLANCY CREEK WETLAND MITIGATION SITE
M-PIT PROPOSED OPEN PIT OUTLINE
CLANCY CREEK DIVERSION
(16-INCH DIAMETER PIPE)
AREA OF PROPOSED M-PIT EXPANSION
AREA OF LAYBACK

WETLANDS LEGEND

WETLAND CLASSIFICATION

POW	Palustrine Open Water
PEM	Palustrine Emergent
PFC	Palustrine Forested
PSS	Palustrine Scrub-Shrub

WATER REGIME

A	Temporarily Flooded
C	Seasonally Flooded
D	Seasonally Flooded/Well Drained
F	Semi-Permantly Flooded
H	Permant
Y	Saturated/Semi-Permant/Seasonal

SPECIAL MODIFIERS

b	Beaver
d	Partially Drained/Ditched
h	Diked/Impounded
s	Spoil

FIGURE 2.3-2
Proposed Action Alternative (M-Pit)
Mine Pit Expansion and Clancy Creek Disturbance

SOURCE: Montana Tunnels 2007

Montana Tunnels Project

Operational Water Resources Monitoring

The water monitoring plan and schedule for Alternative 2 would differ from the No Action plan (Montana Tunnels 2007). Six existing monitoring wells (GW-1, GW-3, MW-1, MW-2, MW-3, and MW-4) would be abandoned in the area of new disturbance, and six new monitoring wells (GW-NEW1, GW-NEW2, GW-NEW3, GW-NEW4, GW-CC1 and GW-CC2) would be added to the water monitoring program. Two existing surface water monitoring stations (SW-16 and SW-16A) would be monitored for water quality parameters in addition to flow. Monitoring well and surface water station locations are provided in Section 3.6, **Figure 3.6-1** and Section 3.7, **Figure 3.7-1**, respectively.

The operational water quality monitoring program for Alternative 2 would not be static or inflexible. The program would remain flexible enough to respond to data trends, changes in informational requirements, and site specific situations.

Surface Water Drainage

Montana Tunnels would operate under the same MPDES permit as described in Alternative 1.

2.3.4 Tailings Storage Facility

The surface elevation and plan area of the tailings storage facility would increase to contain up to an additional 28 million tons of tailings from ore processing (**Figure 2.3-3**). For Alternative 2, all tailings would be stored in the existing tailings storage facility by incrementally raising the tailings storage facility embankment. All of the features for tailings disposal would be consistent with current operations except that the final surface gradient of the facility would be changed such that stormwater runoff flows to the mine pit rather than to the spillway and south pond.

The ultimate tailings surface area would increase from 259.3 acres in Alternative 1 to 272.6 acres in Alternative 2, and would contain up to about 130 million tons of tailings. The tailings elevation would rise approximately 50 feet for Alternative 2. The tailings storage facility disturbance under Alternative 2 would affect 14.4 acres of previously undisturbed surface.

As under Alternative 1, tailings would be discharged along south and north sides of the tailings storage facility, but not along the west side. Under Alternative 2, tailings would also be discharged along the east side of the storage facility to consolidate fine tailings and form a drainage gradient toward the mine pit.

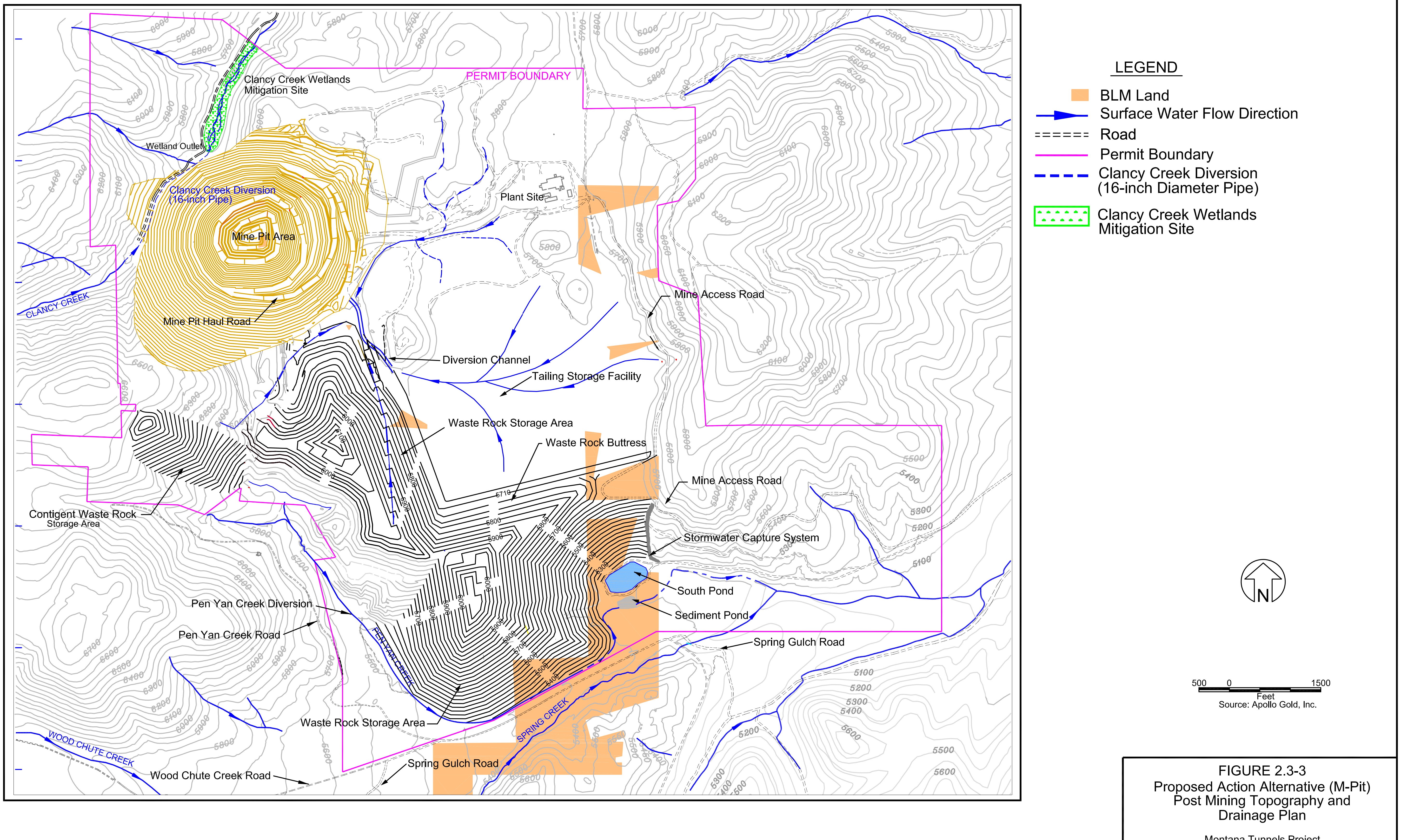


FIGURE 2.3-3
Proposed Action Alternative (M-Pit)
Post Mining Topography and
Drainage Plan

Montana Tunnels Project

Tailings Storage Facility Embankment

The permitted elevation of the tailings storage facility embankment under Alternative 2 would be 5,710 feet. The increased embankment crest elevation would be 50 feet higher than the Alternative 1 crest elevation at 5,660 feet. The waste rock storage area that buttresses the embankment would continue to be raised as staged embankment lifts are constructed to the crest elevation of the tailings storage facility embankment. The design of the Alternative 2 waste rock storage area would tie onto the west portion of the embankment waste rock buttress providing support. The buttress waste rock storage area can hold the amount of waste rock generated under Alternative 2 without changing the footprint.

Seismic Design Parameters, Tailings Density, Wick Drains, Pore Pressures, and Settlement

The seismic design parameters, tailings density, wick drains, pore pressures, and settlement are projected to be the same as Alternative 1.

Tailings Storage Facility Water Quality

Water quality associated with seepage from the tailings storage facility would be identical to Alternative 1. Additional information related to tailings storage facility seepage water quality and quantity is discussed in Section 3.6 (Groundwater). The system for handling tailings storage facility seepage would be the same as that described for Alternative 1. Under Alternative 2, the five existing recovery wells would not pump groundwater to the mine pit during the closure period.

2.3.5 Waste Rock Storage Areas

Under Alternative 2, approximately 46.3 million cubic yards of waste rock would be removed from the expanded mine pit over a 5-year mining period and placed in the 579.1 acres of waste rock storage areas. Waste rock storage areas have been identified to contain the total volume of anticipated waste rock with contingency for excess storage. The portion west of the tailings storage facility would be capped with additional waste rock material. The larger waste rock storage area would extend the waste rock storage area southward across Pen Yan Creek and would cover the existing gravel pit area and a 40.5-acre contingency storage area adjacent to Pen Yan Creek (**Figure 2.3-1**). This contingency storage area was permitted and never used by Montana Tunnels. Under Alternative 2, a portion of the Pen Yan Creek drainage would be realigned around the base of the proposed waste rock storage area footprint. Pen Yan Creek is ephemeral and most flow infiltrates to underlying alluvium and colluvium. The realigned Pen Yan drainage would be designed to mimic the existing drainage and route stormwater to the existing sedimentation pond. Sedimentation pond flow would continue to be diverted

into the south pond through a pipe. Any possible pond overflows would continue to be regulated by MPDES permit MT0028428.

A new 40.5-acre contingency waste rock storage area is proposed under Alternative 2 on the west side of the primary waste rock storage area (**Figure 2.3-1)**. This storage area could contain up to 7.2 million cubic yards of waste rock with final slopes graded at 2.5h:1v for final reclamation. The need for additional waste rock storage in this area is not anticipated with the calculated volumes projected in the Alternative 2 mining plan.

Waste rock storage for Alternative 2 would begin by raising the main waste rock storage area west of the tailings storage facility before extending the waste rock storage area southward across an ephemeral section of Pen Yan Creek **(Figure 2.3-1**). The footprint of the waste rock storage area extension would overlie 123.7 acres of permitted disturbance that has previously been reclaimed and 44.1 acres of other permitted disturbance that is not reclaimed. The expanded waste rock storage area would be constructed and reclaimed using the same design and methods as Alternative 1, but with higher lifts proposed. The waste rock storage area would be built using 150-foot lifts compared to the 50-foot lifts for Alternative 1 (**Figure 2.2-4**). The outside perimeter of each lift would continue to be constructed with waste rock characterized by net neutralizing potentials. Each lift would be set back to facilitate reduction of the waste rock storage area slope to 2.5h:1v during reclamation and to provide sufficient area to construct stormwater drainage ditches on a bench. The drainage ditches would be sized to convey the 100-year, 24-hour runoff event from the waste rock storage area surfaces to the south pond.

The waste rock buttress downstream of the tailings storage facility embankment and modification of the access route to the mill area would provide additional waste rock storage areas for the expanded mine pit mine. Waste rock would be added to the embankment waste rock buttress to fill any unused area that is already permitted for waste rock disposal. Additional waste rock would be added to the buttress as the tailings storage facility embankment is incrementally raised. Waste rock would also be used to construct an access road switchback on the east side of the embankment waste rock buttress and to raise the existing access road above the ultimate tailings elevation (See Section 2.3.6).

Waste rock storage area slopes would be the same as Alternative 1.

2.3.6 Roads and Miscellaneous Areas

<u>Main Access Road</u>

A portion of the main Jefferson County access road would be realigned around the tailings storage facility embankment (**Figure 2.3-1**). The east side of the embankment

and the associated embankment waste rock storage area would be built up with additional waste rock to create a switchback to gain elevation over the ultimate embankment crest at 5,710 feet. The lower section of the existing access road would connect to the switchback road. The straight sections of the switchback extension would be constructed at a 5-percent grade, with a 4.2-percent grade at the wide switchback curve. Permanent access road construction would take place on the east side of the tailings storage facility hillside at an elevation of 5,710 feet.

The existing road upstream of the tailings storage facility embankment and the switchback would be backfilled with waste rock to provide the required elevation along the full length of the realigned roadway. The new access road would provide a route above the elevation of the present tailings storage facility surface on the east side of the tailings storage facility. The lower section of the existing access road would connect to a switchback road on the embankment waste rock storage area. Temporary access during road construction would be provided by extending an interim road from the switch back curve across the tailings storage facility embankment to the west side of the tailings storage facility. The newly constructed main access road would remain at closure as part of the Jefferson County road system. Jefferson County would have to approve the design, and the road would be built to county road standards.

Spring Gulch Road

Under Alternative 1 and as discussed in the 1986 final EIS, the extended waste rock storage area was permitted to cover a section of the Spring Gulch road across the Wood Chute Flats area, but this has not been necessary. Under Alternative 2, this road would be relocated a short distance to the south of the current road (**Figure 2.3-1**). Montana Tunnels plans no interruption to access while the replacement section of the road is constructed. The Spring Gulch road would be replaced with 4,000 feet of gravel road parallel to the base of the waste rock storage area. The new road would reconnect with gravel roads crossing Wood Chute Creek and provide access to Blue Bird Ridge by way of the Wood Chute Creek and/or Pen Yan Creek gravel roads. The road would be constructed by removing soil over glacial outwash material, then spreading and grading screened road mix gravel creating a two-track, 16-foot-wide road with an overall grade of 4 percent. Salvaged soil would be used for reclamation.

Additional Operational Roads

A new service road would be constructed on waste rock storage area slopes to maintain access to new slope surfaces for reclamation and maintenance. During the final year of closure, the road would be reclaimed to tie into established drainage ditches.

The pit and waste rock haul roads would be the same as described in Alternative 1 except the grade would vary from 8 to 12 percent. The southwest haul road corridor reclamation would be the same as Alternative 1 (**Figure 2.3-3**).

Road reclamation would be conducted in the same manner as Alternative 1. The Alternative 2 plan provides the following additional details. Haul roads would be reclaimed using one or more of the following options: (1) an excavator and dozer retrieving and placing the fill material; (2) filling the cut with suitable mine waste hauled in and placed with a dozer; or (3) dozing fill material down from an upper road to fill the road cut below. If it is not possible to recover all fill without disturbing a larger area, the fill material would be regraded to allow revegetation. Montana Tunnels would attempt to backfill the cut portion of the road completely. Any fill material left would be dozed down and blended with the original topography. Stockpiled soil would be spread as the backfilling and slope work is done. The area would then be revegetated.

Miscellaneous disturbance would affect 55.8 acres, including off-site facilities. The net change from Alternative 1 would be 24.9 acres. New disturbance would be 18.8 acres.

2.3.7 Cap Rock, Soil and Gravel Stockpiles

Cap Rock

Similar to Alternative 1, there would be approximately 5 million cubic yards of excess cap rock stockpiled at the mine for Alternative 2. If cap rock stockpiles are not completely used, the stockpiles would be graded, soiled, and seeded consistent with the reclamation plan for other waste rock storage areas.

Soil and Gravel

An additional 70.7 acres would be disturbed for soil and gravel stockpile and contingency areas under Alternative 2. Montana Tunnels projects that at the end of mining a surplus of approximately 400,000 cubic yards of soil would be available for reclamation.

The base of the proposed waste rock storage area would cover the 33.1-acre gravel pit area described under Alternative 1. Montana Tunnels would excavate 300,000 cubic yards of gravel from the existing gravel pit and form a 3.1-acre stockpile for life-of-mine operations (**Figure 2.3-1**).

2.3.8 Reclamation Objectives and Schedule

Reclamation objectives and schedule for Alternative 2 would be the same as those described under Alternative 1.

Topography and Drainage After Mining and Reclamation

Similar to Alternative 1, disturbed areas would be graded to blend with undisturbed topography. **Figure 2.3-3** shows proposed contours after reclamation.

Pit Reclamation

As described under Alternative 1, at closure, most of the mine dewatering system would be shut off, and the pit would begin to fill with water. Disturbed areas around the mine pit would be reclaimed by grading, soiling, and seeding, as in Alternative 1. As in Alternative 1, vertical pumping wells would be maintained on the north, northwest, and southwest sides of the pit for 5 years during closure.

Pit Inflow Sources

Similar to Alternative 1, during the 5-year closure period, the following sources would likely contribute to pit water inflow:

- Groundwater inflow;
- Tailings storage facility runoff;
- Seepage from the tailings storage facility combined drains;
- Groundwater pumped from the recovery well system;
- Water stored in the south pond; and
- Runoff from the catchment area around the pit and the pit highwall.

In addition to the flows used to accelerate formation of a post-mining pit lake in Alternative 1, Montana Tunnels would use part of its water rights on Clancy Creek and divert a portion of Clancy Creek flow during closure to the mine pit.

Total pit surface water catchment area including the area of the mine pit and surrounding natural and reclaimed surfaces would be approximately 1,150 acres, which is approximately 900 acres larger than Alternative 1.

After the 5-year closure period, Montana Tunnels would cease pumping water to the mine pit. The reclaimed tailings storage facility would be designed to send surface water runoff across the tailings storage facility surface to a diversion ditch on the west side of the tailings storage facility that would flow directly to the mine pit.

South Pond

The south pond reclamation would be the same as described under Alternative 1.

Tailings Storage Facility Reclamation

Reclamation of the tailings storage facility would be the same as described in Alternative 1 except as noted below. Under Alternative 2, the tailings surface area would increase from 259.3 acres to 272.6 acres, and the required volumes of fill rock, cap rock, and soil would increase. The spillway designed on the east side of the tailings storage facility embankment for Alternative 1 would not be built. Under Alternative 2, the gradient of the final surface of the tailings storage facility would range from 0.5 percent to 5 percent toward the northwest to direct surface water drainage to the mine pit lake by way of a large drainage channel (**Figure 2.3-3**).

The sandy beaches of the tailings storage facility would be capped immediately following closure. The tailings spigot line would remain in place to apply water from the south pond as necessary to control dust on exposed surfaces of the tailings storage facility.

Tailings Storage Facility Seepage

Seepage from the tailings storage facility would be the same as described under Alternative 1.

Waste Rock Storage Areas

Reclamation of the waste rock storage areas would be the same as described in Alternative 1 except as noted below. Waste rock storage areas would be built in 150-foot lifts (Alternative 2) instead of 50-foot lifts (Alternative 1). The angle of the regraded waste rock storage area slopes would not change from Alternative 1. Drainage ditch design would be the same as the Alternative 1, except ditches would be placed every 150 feet in elevation instead of every 100 feet in elevation (**Figure 2.2-4**). Shallow drainage channels would be created on the waste rock storage area tops to direct stormwater flows to designed channels.

Under Alternative 1, during the closure period all drainage areas would report to the Pen Yan Creek drainage. Under Alternative 2, the drainage on the north slopes of the storage areas would report to the pit by way of diversions and ditches on the waste rock storage areas. The drainage on the south side of the storage areas would report to the realigned Pen Yan Creek channel and to the south pond. Operational and post-mining drainage plans are illustrated on **Figure 2.3-3**.

Miscellaneous Areas and Roads

Reclamation would be the same as Alternative 1 except that the mill, warehouse, office buildings, laboratory, and two outside storage buildings would be cleaned and donated to the Jefferson Local Development Corporation. The remaining structures, ore stockpile cover, conveyors, crusher buildings, substation, truck shop, garage, lube-bay, and tanks would be removed by a salvage company.

2.3.9 Revegetation Plan

The revegetation plan would be the same as that described in Alternative 1.

2.3.10 Post-closure Monitoring and Disposal Plans

Post-closure Water Resource Monitoring

The water quality monitoring program described below would not be static or inflexible. The program would remain flexible enough to respond to data trends, changes in informational requirements and site specific situations.

Water monitoring would be conducted in accordance with the Operational Permit Hydrologic Monitoring Schedule during the 5-year closure period. At the end of closure, the data from the quarterly monitoring would be reviewed. If no adverse changes in water quality or physical characteristics are observed, a recommendation would be made to reduce the sampling frequency for all of the monitored sources to one-half of the quarterly monitoring with possible further reductions for background and upgradient monitor wells.

Additional sampling would be proposed for the filling pit lake to obtain surface samples and samples at depth at least one time per year. The frequency of sampling and parameter list could be modified based on sample results, if appropriate.

Table 2.3-3 provides a conceptual schedule for groundwater and surface water sampling for the 5-year closure period, and beyond.

Surface water monitoring stations that likely would be included in the water monitoring program at the end of the 5-year closure period are provided in **Table 2.3-4**. Groundwater monitoring stations are provided in **Table 2.3-5.**

TABLE 2.3-3 CONCEPTUAL MONITORING SCHEDULE			
Period	**Groundwater Monitoring Stations**	**Surface Water Monitor Stations**	**Pit Lake Sampling Depths**
5-Year Closure Period	17	5	1 Near Bottom (4,200 feet) 1 Surface
5-Year Post-closure Period	14	4	1 Near Bottom (4,200 feet) 1 Mid Lake (4,500 feet) 1 Surface
Years 5-15 Post-closure	6	3	1 Near Bottom (4,200 feet) 1 Mid Lake (4,600 feet) 1 Surface
Years 15-30 Post-closure	6	3	1 Near Bottom (4,300 feet) 1 Mid Lake (4,700 feet) 1 Surface
Greater than 30 Years Post-closure	6	3	1 Near Bottom (4,300 feet) 1 Mid Lake Elev. (4,800 feet) 1 Surface

TABLE 2.3-4 SURFACE WATER MONITORING STATIONS		
Station	**Location**	**Remarks**
SW-3A	Spring Creek by Corbin Water Supply System	Continuous flow
SW-16A	Clancy Creek upstream of mine pit	Parshall flume
SW-16	Clancy Creek at flume above Kady Gulch confluence	Parshall flume
Pit Lake	Center of Lake	Ponded water

TABLE 2.3-5 GROUNDWATER MONITORING STATIONS		
Station	**Location**	**Remarks**
GW-5	Downgradient of tailings storage facility north of Pen Yan	Alluvial; drilled 1984
GW-8	Downgradient of tailings storage facility south of Pen Yan	Alluvial; drilled 1986
GW-9	Downgradient of tailings storage facility south of Pen Yan	Alluvial; drilled 1986
GW-10	Downgradient of south pond in Homestake Creek	Alluvial; drilled 1986
GW-21	Recovery well southeast of south pond	Alluvial: drilled 1987
GW-22	Recovery well southeast of south pond	Alluvial; drilled 1987
GW-27	Recovery well southwest of south pond	Alluvial; drilled 1987
GW-28	Recovery well southwest of south pond	Alluvial: drilled 1987
GW-29	Recovery well southwest of south pond	Alluvial: drilled 1987
GW-34	Recovery well south of south pond	Proposed alluvial well
(GW-New3)	Downgradient of waste rock storage area extension	Proposed alluvial well
(GW-New4)	Downgradient of waste rock storage area extension	Proposed alluvial well
(GW-CC1)	Clancy Creek upstream of mine pit	Proposed alluvial well
(GW-CC2)	Clancy Creek downstream of mine pit	Proposed alluvial well

Tailings Storage Facility Stability Monitoring

The tailings storage facility stability monitoring plan would be the same as described in Alternative 1.

Solid Waste Disposal

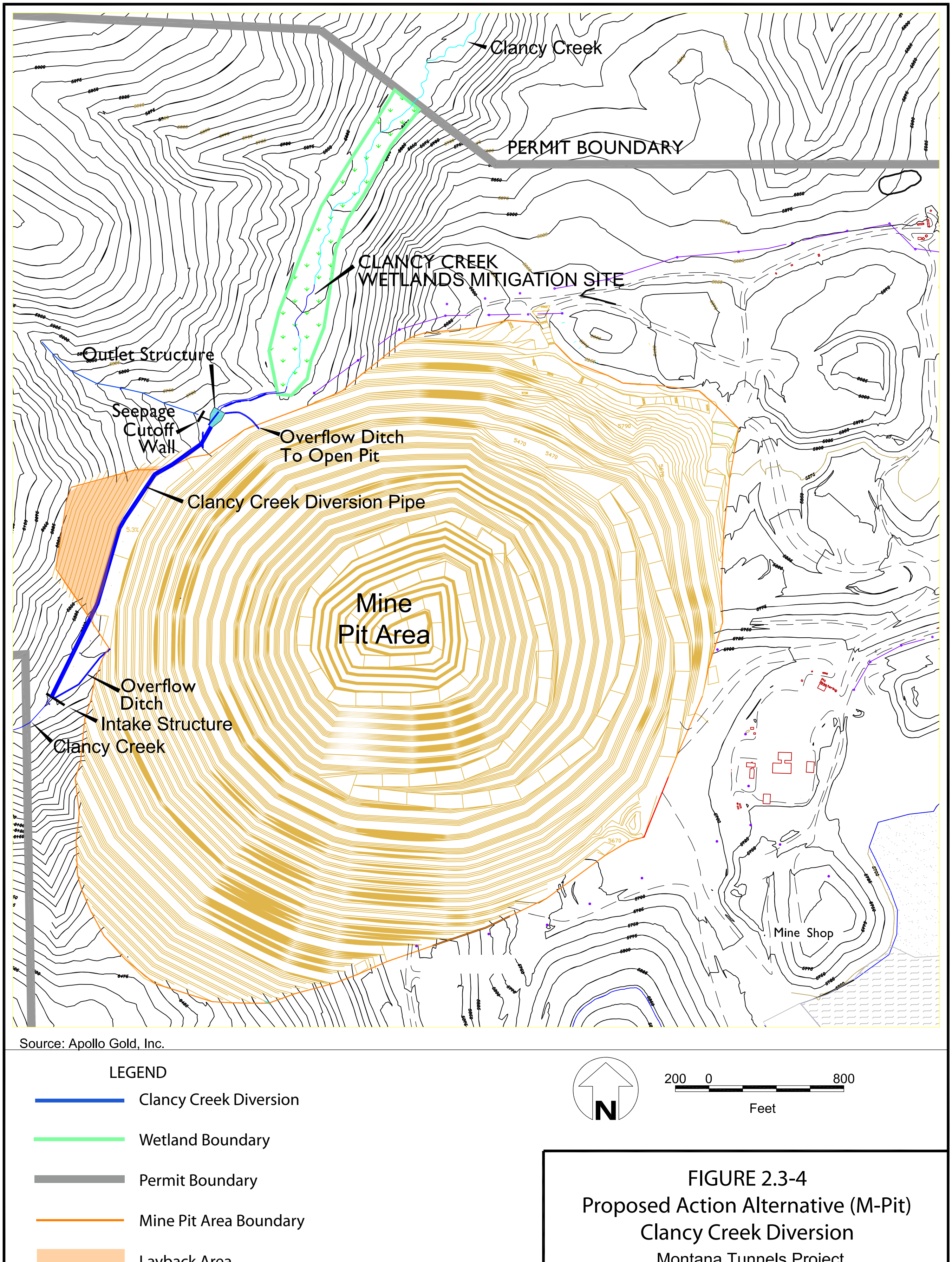
Solid waste disposal would be the same as described in Alternative 1.

2.3.11 Clancy Creek Relocation

The M-Pit Mine Expansion on the northwest side of the mine would excavate and remove approximately 1,800 feet of the Clancy Creek channel and associated wetlands (**Figure 2.3-2**). During mining operations, upstream Clancy Creek surface water and groundwater flows would be diverted around the pit using a combination of a pipe and an open-flow channel (**Figure 2.3-4**). The rerouted flow would rejoin the main Clancy Creek channel downstream of the M-Pit a total distance of 2,600 feet from the upstream diversion.

A cutoff wall for groundwater and a head gate would be constructed to divert water into a 2,000-foot-long 16-inch pipe that would be buried below the ground surface. The headgate would be constructed with a spillway to divert flows greater than the 5-year, 24-hour flow into the mine pit. This water would be managed as process water. The discharge end of the 2,000-foot-long pipe would convey Clancy Creek water to a constructed open-flow channel beginning at an ephemeral drainage on the northwest side of the mine. A bedrock cutoff wall would be constructed across the alluvial channel of the ephemeral drainage to bring groundwater into the constructed channel (**Figure 2.3-4**). The constructed open-flow channel would carry flow from the pipe discharge and flows from the ephemeral drainage around the remaining 600-foot perimeter of the mine pit to the downstream Clancy Creek valley. The open-flow channel portion of the diversion would be lined to prevent water seepage in the area of the mine. The open-flow channel would convey water from the ephemeral drainage and Clancy Creek back to a downstream reconnection point with Clancy Creek.

At the end of mine life, Montana Tunnels would use a portion of the flow in Clancy Creek to assist with flooding of the mine pit. The remaining flow would be used to maintain wetlands along Clancy Creek. The full pit lake would reach equilibrium at elevation 5,625 about two centuries after mining ceases, and no surface water outflow from the pit lake is expected (see Section 3.6, Groundwater for details).



Source: Apollo Gold, Inc.

FIGURE 2.3-4
Proposed Action Alternative (M-Pit)
Clancy Creek Diversion
Montana Tunnels Project

2.3.12 Pen Yan Creek Relocation

Southward expansion of the main waste rock storage area would cover a 3,950-foot-long section of Pen Yan Creek (**Figure 2.3-5**). The present channel of Pen Yan Creek extends along the base of the existing waste rock storage area. Pen Yan Creek is ephemeral during dry years in most of this reach of the stream. The creek's channel conveys stream flows and stormwater to a sedimentation pond and then to the south pond where it is collected and then used in the milling process. Surface water flows in Pen Yan Creek do not leave the mine area.

Montana Tunnels would construct the diversion channel of Pen Yan Creek around the base of the waste rock storage area to convey flow from the Pen Yan Creek drainage and stormwater from waste rock storage area slopes to the existing sedimentation pond. The revised configuration is consistent with the function of the present Pen Yan Creek channel. The realigned channel would be 1,440 feet longer than the natural channel from the point of diversion to the point where the reconstructed channel intercepts the sedimentation pond.

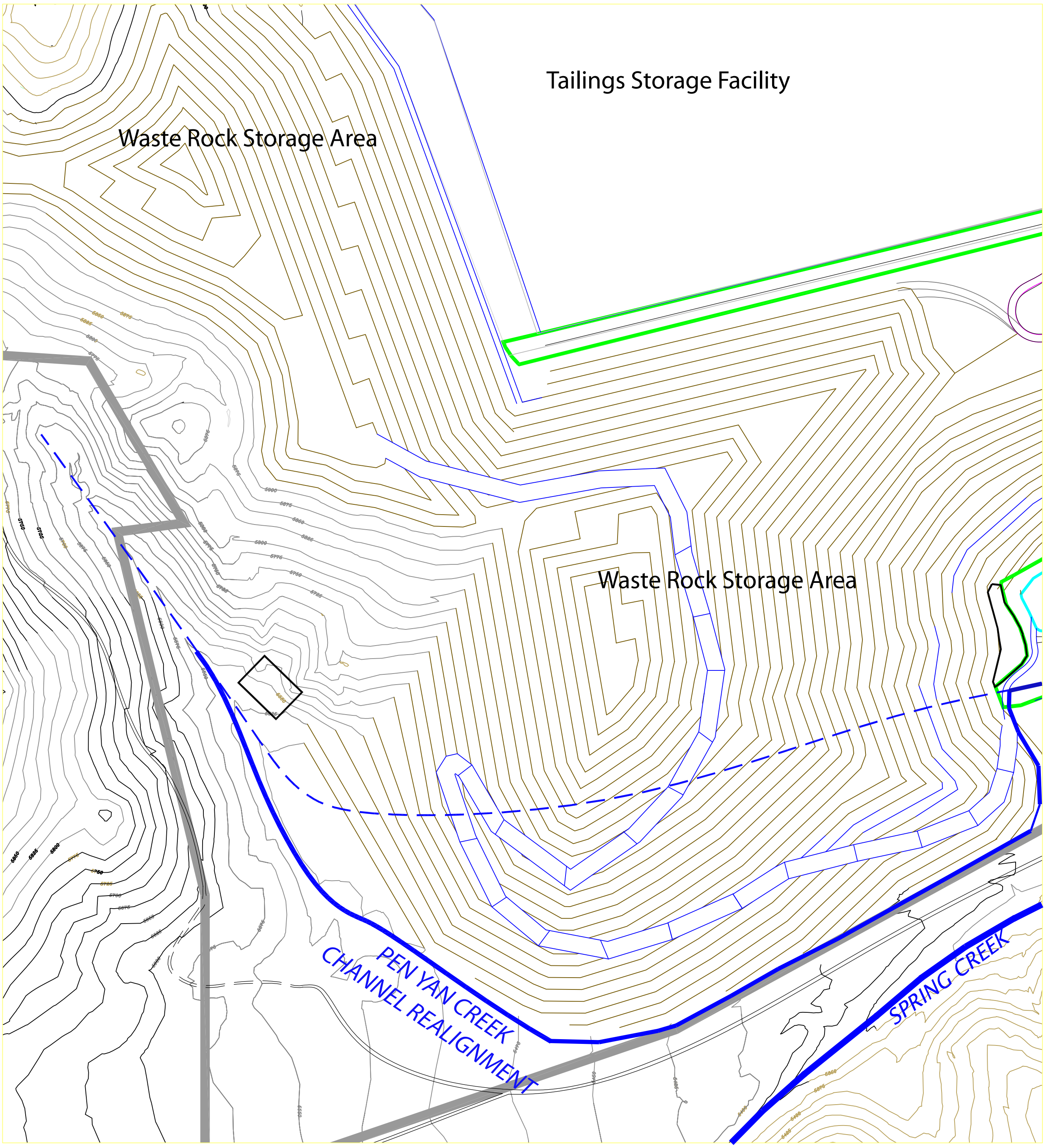
The relocated channel would be constructed in the colluvial material of the Wood Chute Flats glacial outwash and would be designed to be ephemeral, similar to the natural channel that is to be replaced. Groundwater flow in the Pen Yan Creek drainage would not be affected by the proposed mine waste rock storage area construction. Groundwater would be permitted to follow its natural flow path.

2.3.13 Wetlands Replacement Plan

Expansion of the mine pit through the Clancy Creek drainage would affect wetlands and Waters of the U.S. (**Figure 2.3-3** and **Figure 2.3-4**). Jurisdictional wetlands regulations apply to the proposed changes. Plans and areas for wetlands mitigation are proposed by Montana Tunnels, as discussed in **Appendix A**.

Clancy Creek Wetlands Disturbance

About 4.77 acres of delineated wetlands would be disturbed as part of Alternative 2 (Montana Tunnels 2007). Approximately 2.64 acres would be excavated and removed by the expansion of the M-Pit rim and the relocated Clancy Creek channel. An additional 2.13 acres of wetlands would be temporarily impacted in the proposed wetlands mitigation area in order to complete the proposed mitigation. Montana Tunnels proposes to provide 5.13 acres of new mitigated wetlands in the broad Clancy Creek valley downstream of the relocated Clancy Creek channel to compensate for the disturbance of 4.77 acres. A wetlands mitigation ratio of approximately 1.14 to 1 is proposed for the 2.64 acres of wetlands that would be excavated in the expansion area.



Source: Apollo Gold, Inc.

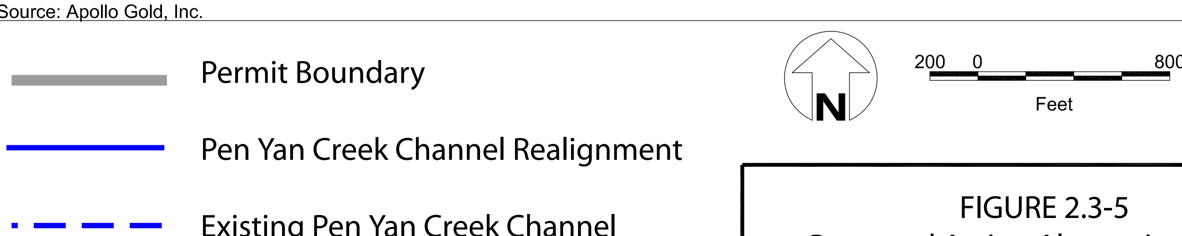


FIGURE 2.3-5
Proposed Action Alternative (M-Pit)
Pen Yan Diversion
Montana Tunnels Project

The water supply for the replacement wetlands would be provided by surface water and groundwater flows from the Clancy Creek diversion and the ephemeral drainage by way of the relocated open-flow channel. Following closure of the mine, a portion of the flow from Clancy Creek would continue to be diverted around the mine pit to maintain the downstream wetlands. Groundwater and surface water flows from the ephemeral drainage would flow to the wetland area. The remaining part of the Clancy Creek flow would be diverted into the mine pit.

2.4 Alternative 3 - Agency Modified Alternative

Alternative 3 would be similar to Alternative 2, with the exception that specific project modifications would be incorporated to address the following important issues:

- Issue A: Post-closure management of tailings storage facility seepage based on the results of water quality monitoring during the 5-year closure period;
- Issue B: Control of wind-blown dust from the tailings surface during closure;
- Issue C: Creation of a natural and more functional dendritic drainage pattern on the waste rock storage area reclaimed surface;
- Issue D: Development of a contingency plan and operational geochemical verification program to handle potentially acid-generating waste rock based on kinetic test results, and on-going monitoring of waste material mined from the M-Pit Mine Expansion zone. Selective handling criteria based on these test results must meet timely material handling requirements in the proposed M-Pit mine plan;
- Issue E: Establishment of a reconstructed Clancy Creek channel soon after commencing the M-Pit Mine Expansion that would convey the 20-year, 24-hour storm event. The lined and reconstructed open-flow channel would be located a sufficient distance from the mine pit rim to ensure stability and thus protect streamflow, wetlands and fisheries;
- Issue F: Implementation of operational and geotechnical measures to ensure Clancy Creek flows do not enter the mine pit in the future; and
- Issue G: Development of additional mitigations required during operations and reclamation.

Project specific modifications to Alternative 2 incorporated in the development of Alternative 3 are summarized below.

2.4.1 Permit Boundary Description

The permit boundary around the active mine areas would be similar to Alternative 2. In addition to the boundary area changes described under Alternative 2, approximately 36.9 acres would be required for the hillside layback required under this alternative to reconstruct the Clancy Creek drainage. The permit area for each alternative is presented in **Table 2.4-1**. All new areas encompassed by the extensions of the permit boundary are on land owned by Montana Tunnels.

TABLE 2.4-1 NO ACTION AND ACTION ALTERNATIVES PERMIT AREA COMPARISON		
Alternative	**Permit Area (Acres)**	**Change in Permit Area from Current Permit (Acres)**
Alternative 1 - No Action (L-Pit Plan)	2,116.0	NA
Alternative 2 - Proposed Action (M-Pit Plan)	2,385.8	269.8
Alternative 3 - Agency Modified Alternative	2,385.8	269.8

Notes: NA = not applicable

2.4.2 Tailings Storage Facility

The construction and operation of the tailings storage facility for Alternative 3 would be the same as described under Alternative 2 with the following exceptions:

- If water quality from the combined drains does not meet groundwater quality standards by the end of the closure period, Montana Tunnels would maintain the south pond and liner system, continue pumping untreated water into the pit, or treat water to ensure the discharge meets groundwater quality standards (Issue A).
- If water in the tailings storage facility combined drains meets all groundwater quality standards, Montana Tunnels would bury the south pond at reclamation to avoid any surface water discharge and continue to monitor groundwater quality during the process of tailings consolidation (Issue A).
- Montana Tunnels would limit wind-blown dust from the tailings surface using an irrigation system to maintain a wetted tailings surface or other dust abatement technology, as appropriate, until such time that vegetation has been established or dust production is otherwise controlled (Issue B).

Waste Rock Storage Area

The construction and operation of the waste rock storage area for Alternative 3 would be the same as Alternative 2 with the following exceptions:

- Montana Tunnels would use a more natural and functional dendritic drainage pattern on the reclaimed waste rock storage area surface, eliminating benches (**Figures 2.4-1 and 2.2-4**). Waste rock storage areas would be constructed with a concave slope, steeper at the top and less steep at the bottom, to provide a natural looking and functioning system (Issue C).

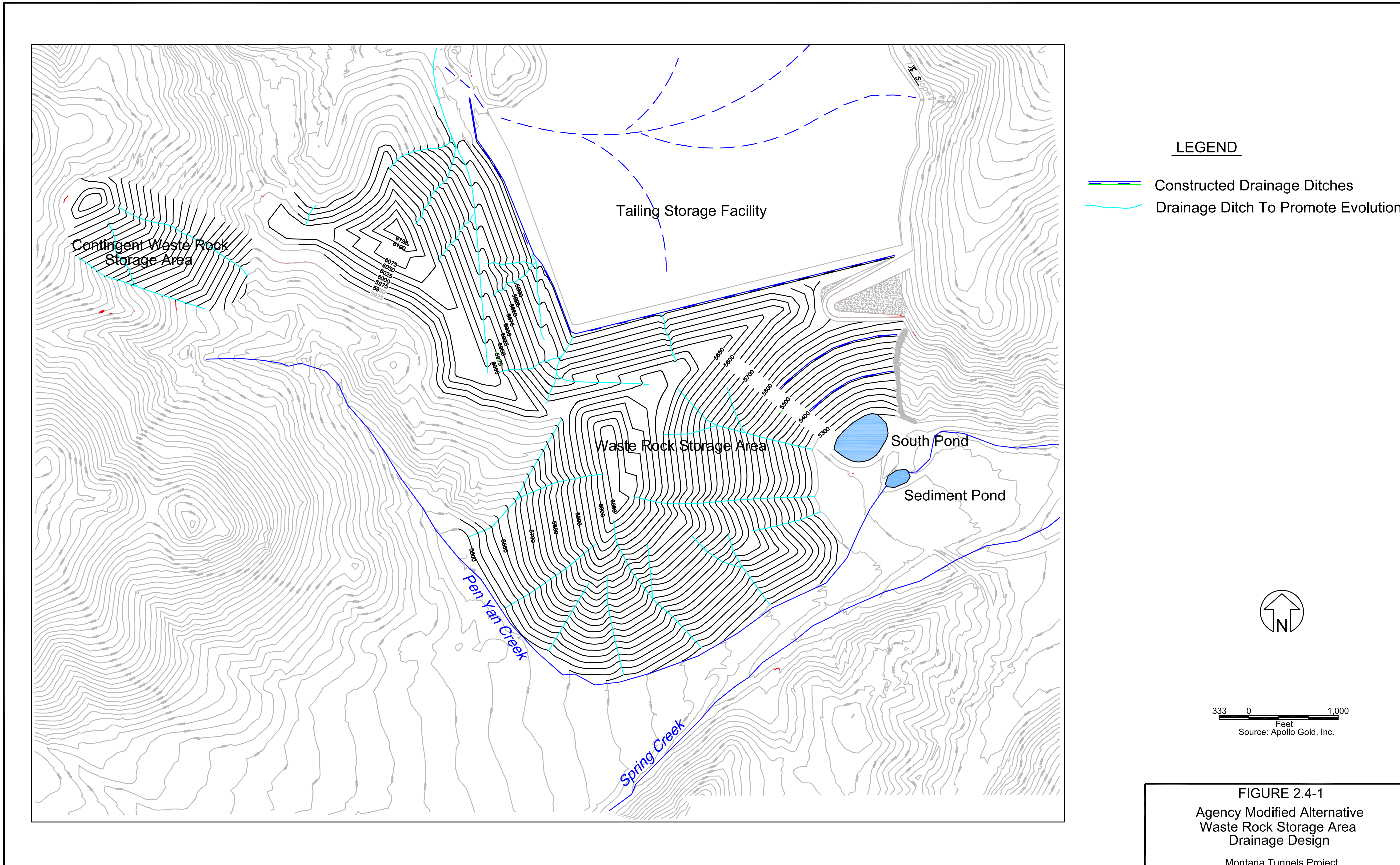


FIGURE 2.4-1

Agency Modified Alternative Waste Rock Storage Area Drainage Design

Montana Tunnels Project

- Montana Tunnels would continue to construct the waste rock storage area using lift heights of 50 feet, as in Alternative 1 (Issue C).
- Montana Tunnels would develop a contingency plan to segregate potentially acid-generating waste rock using an operational geochemical verification program, and either (1) continue to encapsulate potentially acid-generating waste rock in the waste rock storage area or (2) backfill potentially acid-generating waste rock (as determined by static and kinetic testing) into the mine pit after cessation of mining and prior to lake formation to limit oxidation of this waste rock (Issue D).

2.4.3 Reclamation

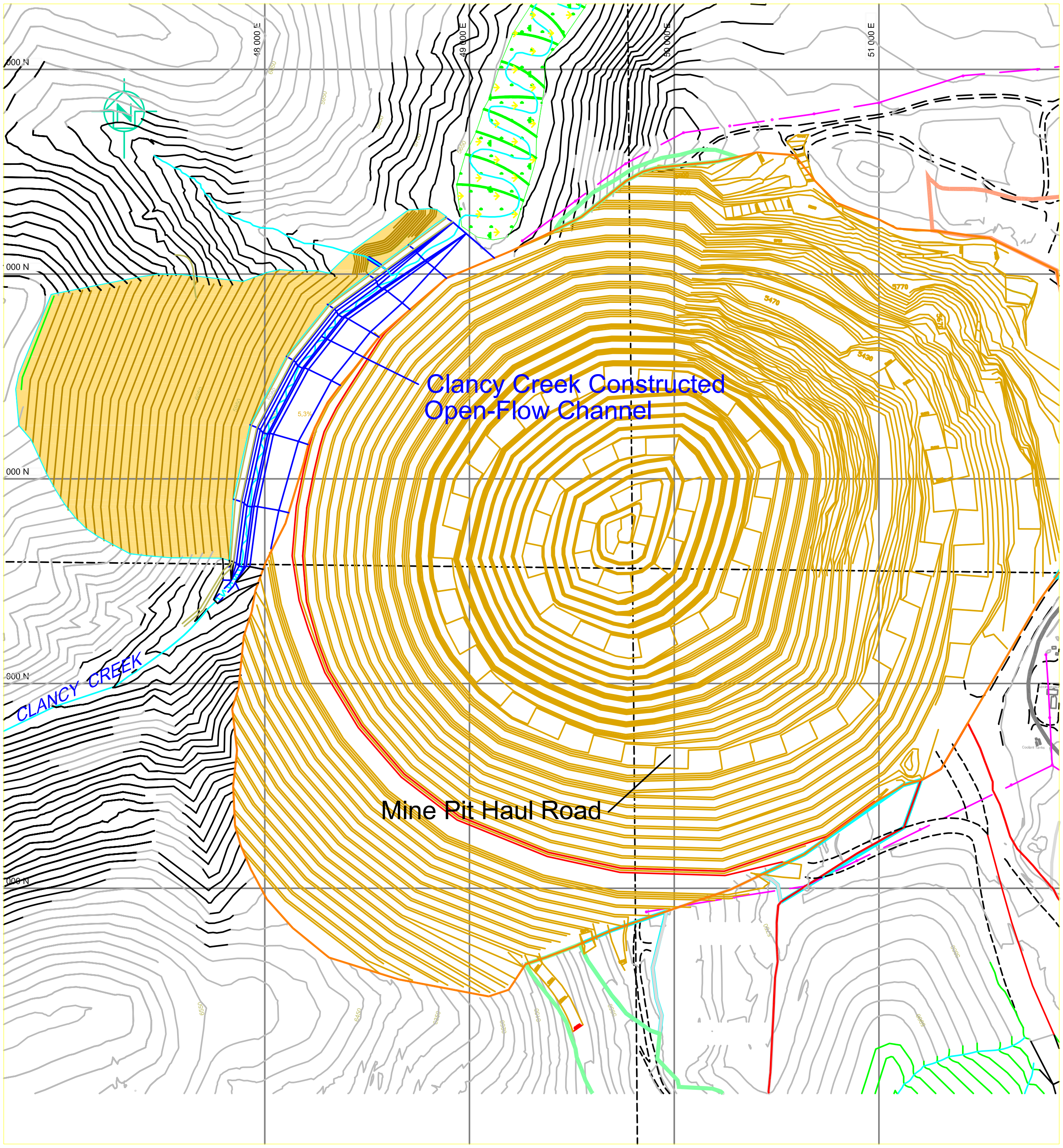
Aspects of mine reclamation for Alternative 3 would be similar to Alternative 2 with the exception of the relocation and reclamation plans for Clancy Creek (see Section 2.4.6).

2.4.4 Clancy Creek Relocation

For Alternative 3, the hillside above the existing Clancy Creek channel in the vicinity of the mine pit (36.9 acres) would be laid back at the beginning of the M-Pit Mine Expansion; approximately 4.8 million cubic yards of excavated rock from the layback would be hauled to the waste rock storage area. The existing waste rock storage area and a 40.5-acre contingency waste rock storage area have sufficient capacity to store rock from the layback.

Montana Tunnels would move the hillside above the channel 300 feet back from the pit rim to provide permanent structural integrity for the constructed Clancy Creek channel (**Figure 2.4-2**). The natural slope above the relocated channel would be laid back at a 2h:1v slope during operations. Soil would be salvaged from the layback slope and used to reclaim the final slope surface. The disturbed layback slope and stream channel bench areas would be reclaimed to create an environment that closely matches existing conditions along the Clancy Creek drainage and surrounding hillsides. To reduce erosion from the layback slope and improve the aesthetics of the layback slope, diversion ditches would be installed at the top of the slope layback and the layback slope would be designed with a dendritic drainage pattern and a concave slope.

After excavation of the layback and stream channel bench is complete, an open-flow channel would be constructed within the bench and around the mine pit that would mimic the present Clancy Creek channel. The overall goal would be to create a stable stream channel that would convey a design flow equal to the 1 in 20 year return period 24 hour storm event. Excess storm flow would be diverted in to the mine pit.



Source: Apollo Gold, Inc.

Layback
Exisitng Clancy Creek Channel
Clancy Creek Constructed Open-Flow Channel
Clancy Creek Wetlands Mitigation Site

N

500 0 1500
Feet

FIGURE 2.4-2
Agency Modified Alternative
Clancy Creek Diversion and Final
Channel Location

Montana Tunnels Project

A wetlands mitigation area would also be developed on Clancy Creek downstream of the mine pit at this time. Preliminary designs for the constructed channel and wetlands mitigation area are provided in **Appendix A**.

Once new vegetation for the constructed open-flow channel and wetlands mitigation area has begun to establish itself, flow in the existing Clancy Creek channel would be routed into the new channel at a point of diversion on Clancy Creek upstream of the mine pit. It is anticipated that activities related to the hillside layback, channel construction, wetlands mitigation, slope reclamation, and re-routing of the existing Clancy Creek would begin immediately upon initiation of M-Pit activities, and would be completed in less than 2 years. The restored channel area would be fenced to discourage cattle grazing and other channel disturbances in order to preserve habitat in the long term.

The management of Clancy Creek surface water would include the following modifications under Alternative 3:

- To protect wetlands and fisheries, Montana Tunnels would incorporate a design for stream flow that is similar to the present Clancy Creek drainage, except the new channel would be lined to limit seepage. (Issue E).
- The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future (Issue E).
- Montana Tunnels would implement operational open pit mining measures to achieve and maintain long-term Clancy Creek stability after closure as outlined in the Knight Piésold stability assessment (Montana Tunnels 2007). In part, stability requirements include low-damage blasting practices, aggressive groundwater depressurization, and implementation of a proactive geotechnical monitoring program (Issue F). These practices would ensure that the reconstructed Clancy Creek channel and all flow less than the design flow do not enter the mine pit in the future.

Stability Assessment

A stability assessment was conducted by Knight Piésold for the proposed Clancy Creek channel (Montana Tunnels 2007). The assessment indicated that localized loosening and raveling of small blocks along the upper slope benches may be expected during mine operations and after closure, and that the lowest factor of safety of 1.4 would be related to a 'critical failure' surface situated approximately 100 feet from the crest of the pit highwall. To ensure long-term stability for the stream channel diversion, the channel would be constructed on a bench 300 feet wide extending back from the mine pit crest. The hillside above the channel would be laid back at a 2h:1v slope. A buffer distance of 200 feet between the pit rim and the channel would be incorporated to provide additional security for the channel. The Clancy Creek channel would be constructed approximately 50 feet from the layback toe (**Figure 2.3-3** and **Figure 2.3-4**)

to ensure that rock and soil that might slough from the slopes above do not block the channel.

The stability assessment report also recommended low-damage blasting, groundwater depressurization, and geotechnical monitoring to ensure stability for the constructed open-flow channel for Clancy Creek. These measures are included as mitigations for Alternative 3 and are discussed in detail in Section 2.4.8.

2.4.5 Topography after Mining and Reclamation

The topography after mining and reclamation would include the following modifications under Alternative 3:

- At the beginning of the M-Pit Mine Expansion Montana Tunnels would move the hillside above the channel 300 feet back (**Figure 2.4-2**) from the pit rim to provide permanent structural integrity for the constructed Clancy Creek channel. This change in topography would be permanent and therefore remain after mining and reclamation activities are complete (Issue F).
- Montana Tunnels would configure the surface of waste rock storage areas as described in Section 2.4.2 above (Issue C).

2.4.6 Operational Geochemical Verification Program

An operational geochemical verification would be required as part of Alternative 3. The geochemical verification program is discussed in detail in Section 3.5.3.3 and summarized below. The operational geochemical verification program would not be static or inflexible. The program would be flexible enough to respond to data trends, changes in informational requirements and site specific situations.

- Montana Tunnels would continue to test the geochemistry of the ore, tailings, and waste rock during operations. Details of the waste rock characterization program are provided in **Appendix D**. The predictions of the existing geochemical model(s) would be verified based on operational geochemical data and testing. Geochemical models could be rerun with operational data to verify existing geochemical models (Issue D).
- Montana Tunnels would monitor tailings storage facility seepage water quality for selected geochemical parameters during tailings consolidation and dewatering (tailings consolidation would occur during the 5-year closure period and is anticipated to continue for several decades thereafter) to evaluate the potential for oxidation of tailings material and future acid rock drainage. (Issue A).
- Montana Tunnels would collect operational geochemical data and conduct testing on material from the layback required to construct the Clancy Creek closure channel to assess potential long-term Clancy Creek water quality issues (Issue D).

Montana Tunnels would monitor tailings water discharged to the pit and post-mining pit lake water quality during the 5-year closure period to verify tailings storage facility seepage water quality predictions, and to verify impacts related to pit lake water quality. All water quality and geochemical data would be evaluated at the end of the 5-year closure period, and the monitoring program requirements would be adjusted by DEQ and BLM, as needed. The monitoring program would continue to be implemented for a time period determined appropriate by DEQ and BLM. (Issue A).

2.4.7 Stability Requirements for Clancy Creek Closure Channel

The stability assessment conducted by Knight Piésold for the northwest pit highwall and the proposed Clancy Creek channel recommended other measures to ensure stability (Montana Tunnels 2007). These recommendations would be incorporated into Alternative 3 and are summarized below.

- Low-damage blasting would be carried out for the final pit highwalls in order to maintain the integrity of catch benches and allow them to contain future rockfalls and raveling. Montana Tunnels would continue to conduct blasting trials in order to optimize blasting practices, improve the reliability of catch benches, and minimize blasting disturbance to the pit highwall.

- Groundwater depressurization would be required along the northwest pit highwall during operations. A combination of vertical pumping wells and horizontal drains would be used to remove groundwater down to 200 feet within the upper slopes and 100 feet in the lower slopes.

- Geotechnical monitoring would continue during operations. Surface prisms would be installed along the new northwest pit rim, as well as at locations where potential instability has been identified. Prism surveying, piezometer monitoring, and inspection mapping would continue at regular intervals to develop a comprehensive record of highwall deformation. Data should be evaluated on an ongoing basis to enable the early detection of instability and allow for safe mining operations. Prism monitoring could be maintained on a less frequent schedule after closure.

- The 2h:1v upper layback slope above the closure channel would be developed in bedrock; and the slope surface would be reclaimed with soil recovered during the layback construction.

- It is recognized that there is a certain amount of geological, geotechnical, and operational uncertainty in any pit operation and it would be prudent to assume that an additional layback may be necessary along the new northwest pit rim.

- A conceptual section of a recommended closure layback bench includes a bench width (from layback toe to pit rim) equal to 300 feet with a 50-foot-wide rockfall protection zone with a single track roadway, a 50-foot channel width, and a 200-foot-wide buffer zone to the pit rim.

- Appropriate groundwater cutoff and collection measures for the updated alternative post-closure Clancy Creek channel.

2.4.8 Additional Mitigations

Additional mitigations were identified and are included in Alternative 3 (Issue G). Additional mitigations include:

- During reclamation of the tailings storage facility surface, the placement of cap material may result in lateral displacement of underlying slimes. It may be necessary to implement a site specific dewatering plan to reduce the fluidity of the slimes to a level where the capping material can be placed without displacement of the slimes. If dewatering of the slimes can not be achieved without delays to the capping plan, (1) an agency- approved geotextile layer would be added to the cap design to create a structural bridge over less stable areas of the tailings, or (2) tailings slimes would be pumped into the mine pit. The choice of mitigation would likely be based on cost.

- Differential settlement of the tailings would occur after the initial cap is installed. In order to maintain the desired drainage pattern of the reclaimed tailings storage facility surface, additional capping material on low areas of the reclaimed surface would be needed to compensate for this settlement. Montana Tunnels would establish a 100-foot by 100-foot survey grid on the tailings storage facility surface after operations cease and before the cap rock is placed. Then as the cap rock is placed, the grid would be checked to ensure the required amount of cap rock and the desired grade is achieved. Montana Tunnels would have to wait until the majority of settlement occurred before the 24 inches of soil is placed. The grid would be checked again to verify that the 24 inches of soil have been placed. Any long-term continued settlement would require additional soil to be placed to reestablish the grade. Montana Tunnels would report the results of the survey annually in the annual report to the agencies and provide documentation that the reclamation gradient has been reestablished on the tailings storage facility surface.

- Impacts to big game (deer and elk) during mine operation and following mine closure would be mitigated by limiting motorized travel in important winter and summer ranges. In addition, the mill, warehouse, office buildings, laboratory, and two outside storage buildings would be donated to the Jefferson Local Development Corporation with the requirement that only existing building sites would be used and all other areas would be reclaimed.

- Site 24JF1825 would be avoided. If avoidance is not possible, an MOU would be developed between Montana Tunnels, the BLM, and the Montana State Historic Preservation Office to mitigate impacts.

2.4.9 Contingencies

Contingencies implemented to address undesirable results from monitoring described above would be addressed in bonding, but are not considered part of this alternative. Potential contingencies are discussed in Chapter 3, if required.

2.5 Related Future Actions

Related future actions are those related to the Proposed Action by location or type. For this EIS, other metal mine projects in Jefferson and nearby counties were considered for evaluation. Subdivisions, Elkhorn Goldfields' proposed Golden Dream Project, located 20 miles to the south of Montana Tunnels Mine, and the impending closure of the Golden Sunlight mine have been established as related future actions for this EIS.

2.6 Alternatives Considered But Dismissed

Two construction-detail project modifications were discussed and considered by the agencies, but were dismissed from detailed analysis. These project modifications are discussed below, along with the rationale for dismissing them from detailed analysis.

Accelerate Formation of a Post-Mining Pit Lake

The option to accelerate formation of a post-mining pit lake by pumping water from Prickly Pear Creek and Spring Creek was considered in order to increase pit highwall stability and create a reducing environment for insulating the sulfide-containing mineralized diatreme in the lower highwalls of the mine pit. This option was dismissed because the same effect would be achieved by natural raveling and sloughing of rock with lower sulfide content from the upper pit highwall as the pit stabilizes.

Castblasting to Reduce Pit Highwalls

Castblasting of pit highwalls to reduce upper pit highwall slopes was considered to accelerate pit filling and cover sulfide rock at the bottom of the pit as soon as possible and increase long-term pit stability. However, castblasting was dismissed because sufficient rock would naturally ravel from benches along the pit highwall to cover the bottom of the pit during the 5-year post-closure period without implementing additional blasting activities.

Affected Environment and Environmental Consequences

Information presented in this chapter describes the relevant resource components of the existing environment. Only resources that could be affected by the alternatives, or that could affect the alternatives if implemented, are described. Data and analyses presented in these sections correspond with the importance of the impact and with concerns raised during the scoping process. The following resource areas are presented in this chapter: geology and minerals; geotechnical engineering; soils, vegetation and reclamation; geochemistry; groundwater; surface water; wetlands; wildlife; fisheries and aquatics; and socioeconomics.

After the environment of each resource that would be affected has been described, the impacts of the M-Pit Mine Expansion Plan, and other alternatives are discussed, including the direct, indirect, and cumulative affects for each resource. Irreversible and irretrievable commitments of resources are also described. The text includes descriptions for impacts and resources relevant to identified issues of concern (Section 1.7). Cumulative impacts are identified only where there is a reasonable likelihood that the alternatives would have a cumulative or incremental effect with other present or reasonably foreseeable actions.

3.1 Location Description and Study Area

The project location and associated study area for the Montana Tunnels Mine was first discussed in the 1986 final EIS on page I-2. A map showing the project location and study area was presented in Figure S-1, page ii of the 1986 final EIS (DSL 1986). The study area for this EIS is comparable to the study area identified in the 1986 final EIS. In general, the study area for this EIS includes all lands and resources within the mine permit boundary, plus those additional areas identified by technical disciplines as "resource analysis areas" that are beyond the mine permit boundary. Resource analysis areas are identified in Chapter 3 for each technical discipline. By definition, the resource analysis areas that extend beyond the mine permit boundary are included in the "study area" for this EIS.

3.2 Geology and Minerals

This section summarizes the regional and site specific geologic setting of the Montana Tunnels deposit and the mineral resources within the mine permit area.

3.2.1 Analysis Methods

The affected environment for geology and minerals was discussed in the 1986 final EIS on page III-1. The impacts to geology and minerals from permitting the original Montana Tunnels project were discussed in the 1986 final EIS on page IV-1. The M-Pit Mine Expansion would continue to disturb the same geologic units.

Analysis Area

The study area for mineral resources includes unconsolidated valley-fill deposits (alluvium and colluvium) and bedrock, including mineable ore reserves and surrounding waste rock within the mine pit area and other bedrock within the permit boundary.

Information Sources

The description of the geologic setting and analysis of mineral resources in the Montana Tunnels area is found in Operating Permit 00113 for the Montana Tunnels Mine (Montana Tunnels 2007) and geologic reports by Smedes (1962) and Sillitoe and Others (1985). Mineral resource information was supplemented by other reports by Roby and Others (1960) and Becraft and Others (1963). Most mine-specific economic data were obtained from Apollo Gold Corporation's (Apollo Gold) website http://www.apollogold.com.

Methods of Analysis

Geology and mineral resources were analyzed by a review of the existing published and unpublished literature and application of a basic knowledge of mining methods, practices, and operations and their impact on the environment.

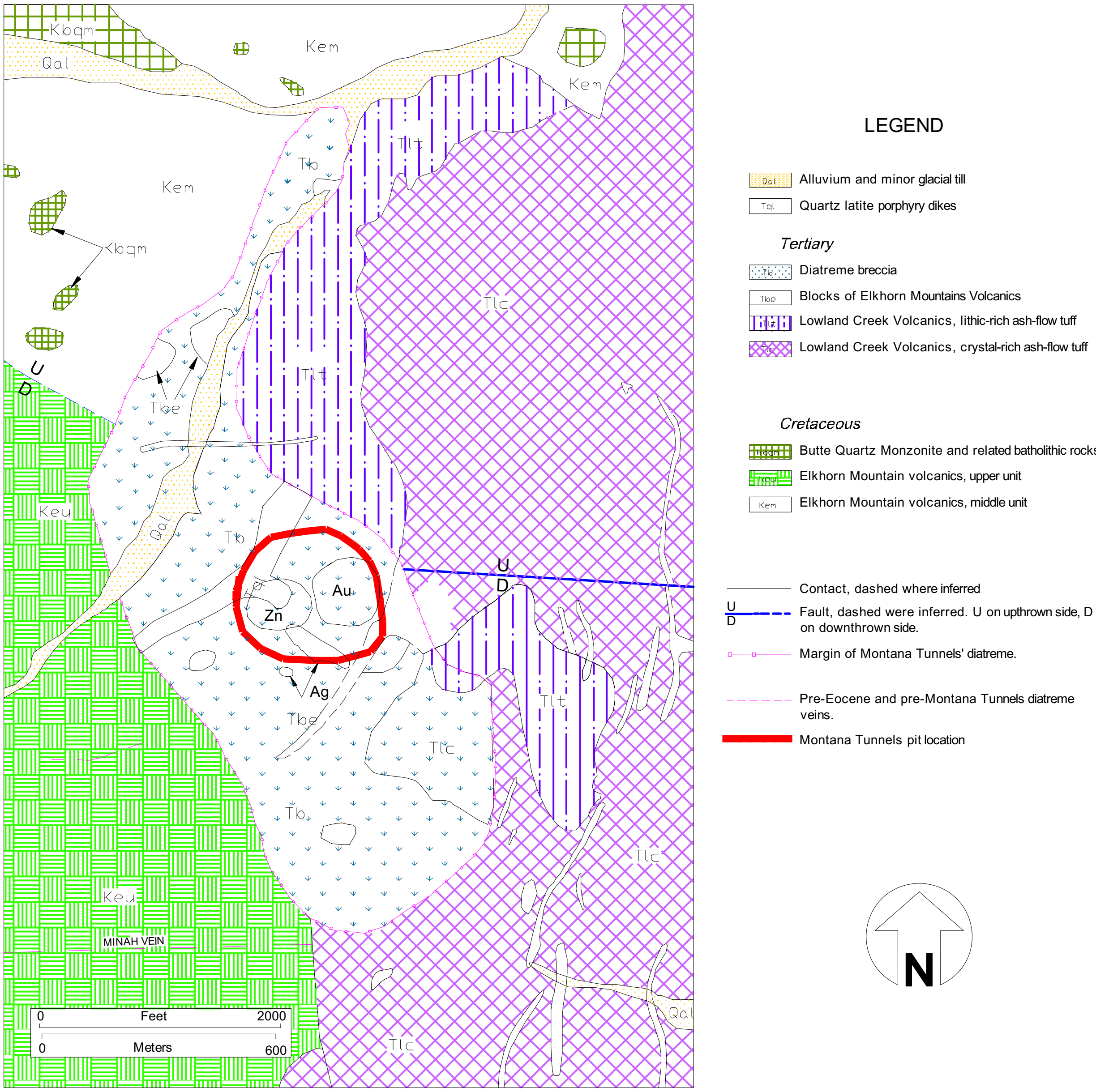
3.2.2 Affected Environment

Regional Geologic Setting and History

Intrusive rocks of the Boulder Batholith (Butte Quartz Monzonite) and extrusive volcanic rocks of the Elkhorn Mountain and Lowland Creek Volcanics dominate the regional geologic setting of the Montana Tunnels area (**Figure 3.2-1**). **Table 3.2-1** lists the rock units in the Montana Tunnels Mine area. The geologic rock units are listed in order from youngest to oldest. The regional geologic setting was described in the 1986 final EIS on page III-1.

TABLE 3.2-1
GEOLOGIC ROCK UNITS IN THE MONTANA TUNNELS MINE AREA

Geologic Unit	Age	Brief Description
Biotite-bearing Quartz Latite Dikes	Middle Eocene, 45 to 50 million years old	Dikes with phenocrysts of quartz, plagioclase and biotite in a microcrystalline matrix, typically 50 feet, but as much as 160 feet wide
Lowland Creek Volcanics	Middle Eocene, 48 to 50 million years old	Volcanic deposits of welded, crystal-rich, quartz-latitic ignimbrites and ash flow, containing fragments of Elkhorn Volcanics probably originating from the Montana Tunnels diatreme
Upper Member Elkhorn Mountain Volcanics	Late Cretaceous, 68 to 78 million years old	Fluvially deposited andesitic, clastic, and tuffaceous siltstones and sandstones derived from erosion of older volcanic rocks; locally exhibiting greenschist metamorphism.
Middle Member Elkhorn Mountain Volcanics	Late Cretaceous, 68 to 78 million years old	Extrusive volcanic rhyolitic or quartz-latitic ignimbrites and ash flow deposits
Boulder Batholith / Butte Quartz Monzonite	Late Cretaceous, 68 to 78 million years old	Quartz-monzonite porphyry, with small composite bodies of alaskite, aplite, and pegmatite in border facies.



Source : Appollo Gold - Montana Tunnels Technical Report

FIGURE 3.2-1

Site Geology

Montana Tunnels Project

Local Geologic Setting

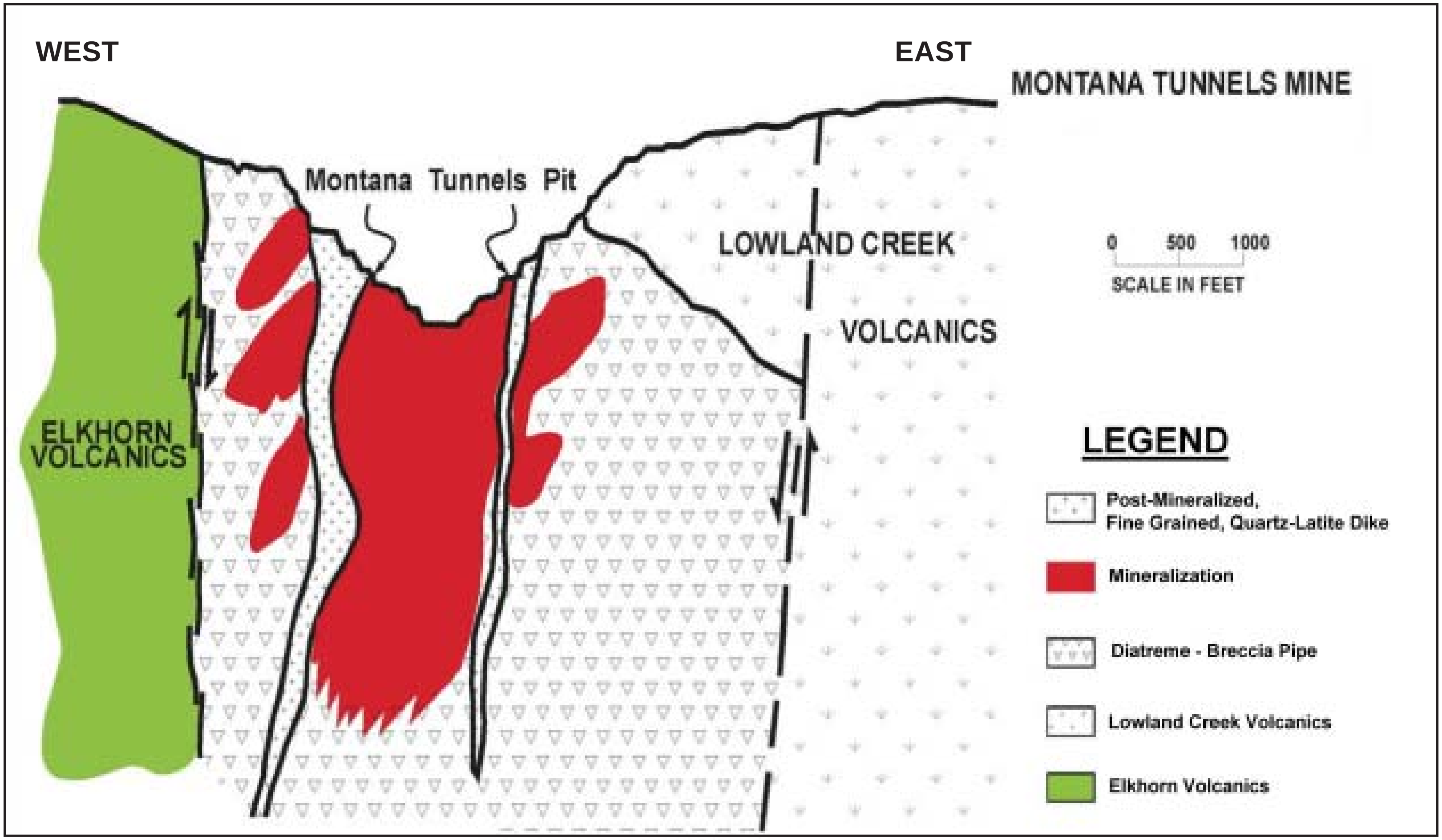
Stratigraphy and the Montana Tunnels Diatreme

The Montana Tunnels ore deposit occurs within a steeply dipping irregular cylindrical zone of altered and brecciated (broken) volcanic rock of Eocene age called a diatreme (**Figure 3.2-1**). The term “diatreme” is the generic name for zones of broken rock produced by intrusive or volcanic gas explosions. These explosions typically vent all the way to the surface and are followed almost immediately by a collapse of material back into the subsiding fragmented rock column.

The Montana Tunnels diatreme is the neck of an extinct volcano, the top of which has been eroded exposing deeper portions of the volcano. The volcano was created by the venting of built-up gas pressure on top of molten rock at depth. As the molten mass rose through the earth’s crust and reached shallower depths, the gas pressure at the top of the mass built up to a point where it exceeded the capacity of the overlying rock to contain the pressure. Once the zone of weakness was encountered, the pressure was released as a violent gas explosion that shattered and mixed the overlying column of rock on its escape to the surface. In the Montana Tunnels diatreme, this explosion is evident by large blocks of near surface volcanics and the presence of carbonized (and locally mineralized) logs within the diatreme. Diatremes are often considered ground preparation events for subsequent mineralization.

Many late stage fine grained biotite-bearing quartz-latite dikes occur in the diatreme area (**Figures 3.2-1** and **3.2-2**). These dikes cross cut the diatreme breccia, the large suspended blocks of volcanic rock within the diatreme, and in places the adjacent Lowland Creek Volcanics. They are typically about 50 feet wide, but can be as much as 160 feet wide.

Figure 3.2-1 shows the diatreme in plan view. It is about 5,000 feet long in a northwest-southeast direction and about 2,500 feet in an east-west direction. The diatreme has been drilled to depths of about 2,000 feet, where its walls are nearly vertical; mineralization continues to at least this depth (Apollo Gold 2004). The diatreme is bounded along its western and southwestern flanks by faults, and the diatreme itself appears to be localized along a north-northwest to south-southeast trending graben (a geologic structure in which a central fault-bounded block is down-dropped with respect to the adjacent blocks) that juxtaposed Elkhorn and Lowland Creek Volcanics across the graben prior to emplacement of the diatreme (Apollo Gold 2004).



SOURCE: Apollo Gold Inc. Technical Report

FIGURE 3.2-2
East-West Section Through
Montana Tunnels Deposit

Montana Tunnels Project

The rock material that fills the diatreme consists mostly of broken rock (breccia) in a sand-sized, gray to white, crumbly volcanic rock matrix. The rock fragments (typically less than 1 inch but as large as 8 inches) consist of various rock types that are rounded by abrasion and randomly suspended in a fine-grained (less than 0.1 inch) matrix that comprises 70 to 90 percent of the rock. The matrix itself is composed of sub-rounded or fragmental grains of feldspar and biotite (now largely altered to clay by hydrothermal processes) and quartz. The diatreme also contains a large number of small pieces (usually less than 1.5 inches but as large as 10 inches) and a few large coherent blocks (several feet to tens of feet in diameter) of volcanic rock that are likely derived from wall rock outside of the diatreme that broke off and subsided into the diatreme.

Mineralization

The Montana Tunnels deposit is located in the south central part of the diatreme and occurs over an area that represents about 10 to 20 percent of the entire diatreme in plan view (**Figure 3.2-1**). Ore deposition occurred from the injection of metal-bearing hydrothermal fluids into the porous, permeable, and highly fractured diatreme breccia (Apollo Gold 2004). The ore contains low-grade gold, zinc, silver, and lead.

Gold is associated with sulfides in veinlets and in disseminations. Gold occurs as inclusions in pyrite, galena, and sphalerite and less commonly as electrum (a natural alloy of gold and silver). Much of the silver is contained in the lead mineral galena. The overall ratio of silver to gold is about 10 to 1. Oxidation of sulfide is minor and extends only to depths of 20 to 40 feet from the surface.

Recent Mining History

Historic mining in the Corbin-Wickes Mining District was discussed in the 1986 final EIS on page III-1 (DSL 1985). Centennial Minerals, Inc. began mining the Montana Tunnels deposit in 1986 under Operating Permit 00113 and the mine has been in nearly continuous operation since that date. Pegasus Gold Corporation (Pegasus) acquired the property in the 1980s. Pegasus Gold filed for Chapter 11 bankruptcy in 1998 and went into Chapter 7 bankruptcy in January 1999. The remaining viable assets of Pegasus, including the Montana Tunnels Mine, were reorganized into a new company called Apollo Gold. Apollo Gold was sold to new owners in 2002 and is currently traded on the Toronto and American stock exchanges. Apollo Gold operates the mine through a wholly owned subsidiary called Montana Tunnels Mining, Inc. Since the mine began production in 1987 it has produced 1.5 million ounces of gold, 28.0 million ounces of silver, 390 million pounds of lead and over 1 billion pounds of zinc (Apollo Gold 2005).

After beginning stripping and highwall layback operations early in 2002, a known and monitored fault to the west of the west wall of the mine pit became saturated with water during an unusually wet spring. Subsequent freezing, thawing and excess water in the fault caused a section of the southwest pit highwall to fail in July 2002. The failure did not impede the stripping program or production from lower grade ores encountered during either 2002 or 2003.

The next phase of mine pit stripping and layback began in October 2003 and was completed in December 2004. Total production costs per ounce of gold were $534 per ounce for 33,743 ounces in 2004, reflecting the costs associated with the higher stripping ratios. Historical costs of $188 for 2002 (26,657 ounces) and $326 for 2003 (33,743 ounces) were reported for previous years. **Table 3.2-2** presents the 2004 production summary.

TABLE 3.2-2
MONTANA TUNNELS 2004 PRODUCTION*

Metal	Quantity	Units	Grade
Gold	33,743	ounces	0.016 ounce gold per ton
Silver	970,751	ounces	0.46 ounce silver per ton
Lead	10,064,265	pounds	0.24%
Zinc	26,222,805	pounds	0.62%

Notes:
* Total ore mined was about 2.1 million tons
Source:**http://www.apollogold.com/Apollo_Gold/RIGHT/news/news031605C.htm**

The objective of both of these stripping phases was to provide access to 18 million tons of mineable ore in the K-Pit and L-Pit configurations for a 4-year mine life extension. All permits were in place to complete K-Pit and L-Pit configuration development and mining work.

Also during 2003 and 2004, mill upgrades included installation of a new primary crusher and a modification to the grinding circuit. The objective of these upgrades was to increase mill throughput from 425,000 tons to 475,000 tons per month. With the stripping and layback of the mine pit highwall and the upgrades to the mill completed, Montana Tunnels was expected to reach the ore grade material and return to the historical gold production rates of approximately 70,000 ounces per year late in the fourth quarter of 2004 (Apollo Gold 2004a).

At the end of 2004, Apollo Gold announced proven and probable reserves for Montana Tunnels as 40.8 million tons with a grade of 0.016 ounce of gold per ton for a total of 643,800 contained ounces of gold (**Table 3.2-3**). These reserves were contained both in the existing K-Pit and L-Pit and proposed M-Pit Mine expansions for the project. The reserves were based on a cut-off gold price of $375 per ounce.

Late in 2004, Apollo Gold submitted an application to amend its operating permit that proposed an additional 5-year mine life based on known reserves (**Table 3.2-3**). These reserves included 402,900 ounces of gold contained in the proposed M-Pit Mine Expansion.

TABLE 3.2-3
MONTANA TUNNELS PROVEN AND PROBABLE RESERVES*

Metal	Quantity	Units	Grade
Gold	643,800	Ounces	0.016 ounces of gold per ton
Silver	8,990,500	Ounces	0.46 ounces of silver per ton
Lead	147,116,900	Pounds	0.180 %
Zinc	465,870,000	Pounds	0.570 %

Notes:

* Figured at a cut–off gold price of $375 per ounce gold, as of December 31, 2004.
Source: **http://www.apollogold.com/Apollo_Gold/RIGHT/news/news0316b05.htm**

Mining continued through the first three quarters of 2005. On October 21, 2005, Apollo Gold suspended mining operations due to geotechnical instability and failure of the eastern mine pit highwall. Apollo Gold, with the assistance of outside consultants, undertook a technical review of potential pit access options to determine safe alternatives to allow access to the mine pit. Several alternatives were developed with capital costs ranging from $6 million to $12 million. Over the next several months, the mill was kept in operation but reduced to processing existing low-grade ore stockpiles. In May 2006, Apollo Gold announced that low-grade ore stockpiles had been exhausted. All operations at its Montana Tunnels Mine were stopped, and the mine was placed on care and maintenance (Apollo Gold 2006).

In August 2006, Apollo Gold entered into a joint venture (JV) agreement with Elkhorn Tunnels, LLC (Elkhorn Tunnels). The JV Agreement called for Elkhorn Tunnels to earn up to a 50 percent interest in the Montana Tunnels Mine by contributing $13 million over a 5-month period. The money was to be used to remediate the east mine pit highwall instability problems. Under terms of the agreement, Montana Tunnels was to continue as the mine operator with a separate oversight management team consisting of two designees each from Montana Tunnels and Elkhorn Tunnels. Elkhorn Tunnels would oversee monthly planning and operations.

In addition to the JV Agreement, Apollo Gold entered into two other agreements with Elkhorn Goldfields, Inc. (Elkhorn Goldfields), an affiliate of Elkhorn Tunnels. The first agreement was an option agreement pursuant to which Elkhorn Goldfields was granted an option to purchase Apollo Gold's Diamond Hill mine for $0.8 million. The underground Diamond Hill gold mine is situated 28 miles southeast of Helena, Montana and has been on care and maintenance since 2000. The second agreement was a custom milling agreement pursuant to which Elkhorn Goldfields would have the right to have Montana Tunnels process the ore from Elkhorn Goldfields' proposed Golden Dream Project, located 20 miles to the south of the Montana Tunnels Mine, through the 1,000-ton-per-day Diamond Hill Mill. The Diamond Hill Mill is located within the Montana Tunnels mill complex, and the Diamond Hill Mine historically shipped ore to the mill at Montana Tunnels. The custom milling agreement also gives Elkhorn Goldfields a 2-year option to purchase the Diamond Hill Mill for $1 million (Apollo Gold 2006).

The remediation plan for the unstable east mine pit highwall at Montana Tunnels included the unloading of 2.4 million cubic yards of waste rock from the upper benches of the east highwall to mitigate rock fall hazards by reducing slope deformation and rock mass degradation in the weak rock units exposed along the upper east highwall. A new, wider haul ramp was constructed to reduce the potential for haul ramp instability along the east highwall. In addition, 1.2 million cubic yards of waste rock from the mine pit bottom were also removed (Apollo Gold 2006).

The mine pit highwall stabilization work and the construction of a new haulage ramp were completed in January 2007. Since January, Apollo Gold has continued to move waste rock from the mine pit bottom to expose the ore body and stockpile some low-grade ore near the mill. As of February 28, 2007, there were 333,000 tons of lower grade material and 45,000 tons of reserve grade ores stockpiled alongside the mill for future processing.

The Montana Tunnels mill was placed back into service on March 1, 2007. The mill is expected to operate at an average rate of 15,000 tons per day for the balance of 2007. The expected products are gold and silver doré, a lead-silver-gold concentrate, and a zinc-silver-gold concentrate (Apollo Gold 2007). Both concentrates will be transported via rail to the Teck-Cominco smelter located at Trail, British Columbia, Canada. The doré would be refined in Salt Lake City by Johnson Matthey Inc. refineries.

The March 2, 2007, news release restated December 31, 2006, ore reserves at the Montana Tunnels Mine through the M-Pit Mine Expansion at 35.7 million tons containing 551,669 ounces of gold and 414.0 million pounds of zinc. No new definition drilling was conducted during 2006. **Table 3.2-4** summarizes the current proven and probable reserves.

TABLE 3.2-4 MONTANA TUNNELS PROVEN AND PROBABLE RESERVES THROUGH M-PIT MINE EXPANSION DECEMBER 31, 2006 [1]							
Mine Pit Design	**Classification**	**Tons**	**Gold**	**Silver**	**Lead**	**Zinc**	**Gold Ounces**
L-Pit	Proven	10,357,546	0.0159	0.169	0.219	0.587	164,916
	Probable	214,402	0.0151	0.180	0.209	0.509	3,236
Total	**L-Pit Reserves**	**10,571,948**	**0.0159**	**0.170**	**0.219**	**0.585**	**168,152**
Total M-Pit	Probable[2]	**25,120,423**	**0.0153**	**0.227**	**0.166**	**0.578**	**383,517**
Total Reserves	**L-Pit and M-Pit Reserves**	**35,692,371**	**0.0155**	**0.210**	**0.181**	**0.580**	**551,669**

Notes:
[1]The above ore reserves were calculated using the past 3 years average metal prices: Gold -$485/oz., Silver - $8.50/oz., Lead - $0.47/lb., and Zinc - $0.87/lb (Apollo Gold 2007).
[2] Note that M-Pit reserves are probable reserves.

3.2.3 Environmental Consequences

Mining affects geologic materials and mineral resources by excavating ore and waste rock and by relocating waste rock into surface waste rock storage areas. The processing of ore results in the removal of gold and sulfide minerals from the ore, and the relocation of ore-processing wastes to the tailings storage facility.

Relocation of mining wastes to surface storage facilities temporarily removes these areas from their previous beneficial land use creating an adverse impact of short-term duration until surface reclamation and revegetation of the facilities is complete. At the same time surface storage of mining wastes creates a permanent (long-term) adverse impact, by altering the existing surface topography and burying natural geomorphic features. Open pit mining, in addition to permanently altering surface topography, also permanently and adversely impacts previous beneficial land uses in the mine pit area proper. The mining of the ore deposit creates a short-term beneficial impact by providing a resource presently in demand, but a long-term adverse impact on mineral resources by making them unavailable for mining by future generations. However, the products of the mined ore (metals) would be used for generations.

3.2.3.1 Alternative 1- No Action Alternative (L-Pit)

Under the No Action Alternative, mining at the Montana Tunnels Mine is projected to continue into 2009 (a period of 23 years since mining began) with a total adverse direct

impact of disturbing 1,181.4 acres of ground within its 2,116-acre permit boundary over the mine life (**Figure 2.2-1** and **Table 2.2-1**).

Direct adverse and permanent (long-term) impacts of Alternative 1 on geologic and mineral resources would include the generation and permanent surface disposal of a total of 102 million tons of ore and 122.3 million cubic yards of waste rock mined from an open mine pit covering 248.4 acres. Relocated mined wastes are stored in a waste rock storage facility that covers 425.9 acres (not including a 42-acre contingency area) and milled ore wastes are deposited in a tailings storage facility that covers 259.3 acres.

Construction of waste rock storage areas and tailings facilities and excavation of a mine pit create an adverse permanent modification of surface topography by excavation of rock and by burial of natural geomorphic features. In addition, construction of mine waste rock storage facilities creates an adverse short-term loss of beneficial land use until reclamation is complete, at which time reclamation would return the land to useful productivity comparable to the premining condition.

The open mine pit, although slated for reclamation, would likely create an adverse permanent impact to most beneficial land uses. Pit stability is discussed in the geotechnical section.

Construction of other mine related facilities (milling and processing facilities, haul, exploration and access roads, power lines, and other facilities) would create adverse short-term surface disturbances and temporarily remove portions of the land from the previous beneficial use. Upon mine closure and removal of the facilities, this disturbed land would be recontoured and reclaimed, returning it to a level of productivity and beneficial use comparable to premining conditions of adjacent land.

Mined ore would be permanently removed from existing mineral resources and would not be available for use by future generations. However, the products of the mined ore (metals) would be used for generations.

3.2.3.2 Alternative 2- Proposed Action Alternative (M-Pit)

Under the Proposed Action M-Pit Mine Expansion, mining at the Montana Tunnels Mine would continue through 2013 (a period of 27 years since mining began) with an adverse long-term direct impact of disturbing 1,452.2 acres (including 92.2 acres of contingency areas that are not likely to be disturbed) within a 2,385.8-acre permit area (**Figure 2.3-1** and **Table 2.3-2**). This would be a net increase of 252.7 acres (21 percent) of surface disturbance and 269.8 acres (13 percent) of permit area over the No Action Alternative.

Direct adverse and permanent impacts of Alternative 2 on geologic and mineral resources would include the generation and permanent surface disposal of 126 to 132 million tons of ore and 168.5 million cubic yards of waste rock mined from a mine pit that would cover 287.7 acres. This would be a net increase of 24 to 28 million tons of mined and processed ore (26 to 33 percent), and 46.3 million cubic yards of mined waste rock (27 percent). The net change in pit plan area size of 39.3 acres would be a 16 percent increase over the area of the pit under Alternative 1.

Relocated mine wastes would be stored in waste rock storage areas that would cumulatively cover 579.1 acres (including a 40.5-acre contingency storage area) and a 272.6-acre tailings storage facility. This represents a net increase in mine waste rock storage of 153.2 acres (36 percent), and a 13.3-acre (5 percent) increase in the tailings storage facility.

As with the L-Pit Plan in Alternative 1, the expansion of the waste rock storage areas and tailings facilities and the mine pit associated with the M-Pit Mine Expansion would create adverse permanent modifications of surface topography. In addition, expansion of mine waste storage facilities would create an adverse short-term loss of beneficial land use until reclamation is complete. The expanded mine pit area would likely create an adverse permanent impact to most beneficial surface land uses.

Construction of other mine related facilities (milling and processing facilities, haul, exploration and access roads, power lines, and other facilities) also would create adverse short-term surface disturbances and temporarily remove portions of the land from the previous beneficial use creating a short-term adverse impact until reclamation is complete.

Mined ore removed from the ground at Montana Tunnels would be permanently removed from existing mineral resources and would no longer be available for use by future generations. However, the products of the mined ore (metals) would be used for generations.

3.2.3.3 Alternative 3- Agency Modified Alternative

Under Alternative 3, impacts to geology and mineral resources would be similar to those described for Alternative 2 with one exception. A layback of the hillside would be required to construct the new Clancy Creek channel west of the current location. Construction of the Clancy Creek channel would create an adverse short-term direct impact by disturbing additional 36.9 acres. A long-term beneficial impact would result from creating a stable stream channel that would mimic the existing Clancy Creek channel. Other impacts of the constructed channel are discussed in the surface water, fisheries, and wetlands sections. For Alternative 3, the acres of new disturbance would be an unavoidable impact to natural surface topography.

3.3 Geotechnical Engineering

This section discusses geotechnical engineering concerns including stability of the pit highwalls, waste rock storage area slopes, and the tailings storage facility embankment.

The pit design for the original Montana Tunnels Mine was described in the 1986 final EIS on page II-2. The waste rock storage area design was described in the 1986 final EIS on page II-4. The tailings storage facility embankment was described in the 1986 final EIS on page II-8. The analysis methods for this EIS are summarized below.

3.3.1 Analysis Methods

Analysis Area

The analysis area for geotechnical engineering includes the mine pit, the tailings storage facility embankment and impoundment, the waste rock storage areas, and adjacent improvements and undeveloped land in the Montana Tunnels permit area.

Information Sources

Information for the analysis of the geotechnical engineering issues was found in Operating Permit 00113 for the Montana Tunnels Mine (Montana Tunnels 2007).

Methods of Analysis

Geotechnical engineering concerns were analyzed using limited equilibrium techniques to assess the stability of the existing mine pit, tailings storage facility embankment, and waste rock storage areas under both static and seismic loading conditions. Computer software including the SLOPE/W program developed by Geo-Slope International Ltd. was used to estimate the degree of stress relaxation that would result from deepening the mine pit. This computer program provided an estimate for a factor of safety against a large-scale failure of the pit highwall both during operation and after closure under different post-mining pit lake water level conditions. A minimum factor of safety of 1.3 for both pit operational and post-closure conditions is consistent with stability objectives accepted at other large-scale mining operations.

3.3.2 Affected Environment

This section describes the affected environment in terms of geotechnical engineering concerns including the stability of the existing mine pit, tailings storage facility embankment, and waste rock storage areas.

L-Pit Mine

The L-Pit as presently permitted has a total surface area of 248.4 acres (see **Figure 2.2-1**). The ore and part of the waste rock within the mine pit are primarily light colored, homogeneous breccia having a high matrix to clast ratio (see Geology Section 3.2 of this EIS). Soil and nonacid-generating waste rock have been removed and stockpiled for reclamation activities. On the north and east sides of the pit and along the pit access ramps, the predominant waste rock is Lowland Creek Volcanics (ignimbrites). On the southwest side, the predominant waste rock is Upper Elkhorn Mountain Volcanics (andesitic volcaniclastics).

The permitted L-Pit bottom is the 4,250-foot elevation. The maximum elevation of the pit disturbance would be on the southwest side of the mine at 6,430 feet. Through completion of the L-Pit mining operation, an estimated 122.3 million cubic yards of waste rock and 102 million tons of ore would be removed.

Pit mining practices at the site, including drilling, blasting, loading, and hauling, generally take place on benches separated by 20-foot highwalls. Rock-fall catch benches varying in width from 25 to 60 feet have been constructed on the pit highwalls at approximately 100-foot-elevation increments as mining progresses to the bottom. A single 90-foot wide haul road at a maximum grade of 12 percent is used to access the pit, entering on the east side of the mine at an elevation of 5,650 feet. The haul road switchbacks on north to south headings on the east side of the mine about half way down the pit, then runs along to the south side of the pit with east to west switchbacks to reach ore and waste rock at depth.

Surface water enters the pit from precipitation and runoff from a 241-acre catchment area around the pit. Excavation of the pit below the groundwater table caused lowering of the water table and inflow of groundwater into the pit. Surface and groundwater that flows into the pit collects in the pit bottom. This water along with water collected from pit highwall dewatering wells is removed from the pit by pumping the water through a series of staging tanks to a common pit sump and then transferred to the tailings storage facility where it is used as process water.

Where stability is affected by hydrostatic pressure on the pit highwalls, dewatering is conducted as required. Pit highwall dewatering is accomplished by installing dewatering wells peripheral to the pit, or by drilling horizontal holes into the pit highwalls to drain trapped water.

Instability has occurred along several sections of the pit highwalls since the start of mining. A summary of the highwall failures experienced to date is presented below.

Southwest Highwall

In late 1995, signs of instability were recognized along the upper southwest highwall within the overlying Elkhorn Volcanics. This potential instability was interpreted to be a wedge failure, and was closely monitored by means of survey prisms and extensometers (Montana Tunnels 2007). Monitoring showed that the rates of movement gradually increased, with accelerated rates of movement identified during the 1996 spring thaw. Movements of about 1 foot per day were recorded immediately prior to the failure of approximately 481,000 cubic yards of rock debris that was contained along several catch benches. About 159,000 cubic yards of the failed material were removed to mitigate the condition. Moderate precipitation occurred prior to this failure and most likely was a contributing factor. This instability was recognized and closely monitored by Montana Tunnels prior to failure and resulted in minimal delays to mining activities. No safety incidents were recorded and all personnel and equipment were protected.

In the spring of 2001, an instability was observed along the upper southwest highwall, when tension cracks in the Elkhorn Volcanics were first identified behind the crest of the highwall. These cracks were investigated by Montana Tunnels, and were interpreted to represent the back scarp of a potentially large structurally controlled instability (Montana Tunnels 2007). The size of the instability was estimated to be about 4.8 million cubic yards, and was believed to have been caused by stress relaxation within the highwall due to mining. This instability was closely monitored and movement rates recorded during 2001 were approximately 0.025 foot per day. Further tension cracks were observed after the 2002 spring thaw and movement rates increased to approximately 0.03 foot per day in April and May 2002. Mining was stopped in early June 2002 due to continued raveling and unsafe conditions. Movement rates increased to 0.5 foot per day in mid to late June 2002. By late June 2002, movement rates on in the order of 1 to 2 feet per day were recorded on several prisms. On July 3, 2002, an estimated 3.9 million cubic yards of waste rock fell into the pit.

Northwest Highwall

Wedge failures occurred near the crest of the northwest highwall adjacent to Clancy Creek in July 1996 and again in July 1997. Tension cracks developed concurrently with the July 1997 wedge failure and extended along approximately 1,500 feet of the mine pit crest adjacent to Clancy Creek. The 1997 wedge failure occurred as a result of toppling movements and loosening of the upper slope. A stability assessment, carried out by Knight Piésold in 1997 to 1998 (Montana Tunnels 2007), recommended flattening the upper slope to 40 degrees as well as installation of horizontal drains and piezometers. Montana Tunnels completed the layback during 1998 and progressively installed horizontal drains as mining progressed in this area. The installation of the horizontal drains has successfully resulted in a drawback of the groundwater table. Satisfactory northwest highwall performance was achieved thereafter.

North Highwall
To date, the north highwall has not experienced any instability other than occasional rock raveling and sloughing.

East Highwall
A large wedge, involving an estimated 2.4 million cubic yards of rock, began to move in 1995 along the upper northeast highwall within the Lowland Creek Volcanics. A layback was subsequently implemented to stabilize it. In 1997, instabilities occurred at two locations along the contact of the diatreme and the biotite-bearing quartz latite dike in the east highwall. In addition to these discrete events, tension cracks have formed along the entire length of the east highwall. A review of data from an electronic instrument used to characterize and locate faults (time domain reflectometer) suggested that these tension cracks were indicative of deep-seated displacements extending up to 200 feet behind the pit highwall. The tension cracks are believed to have developed from a combination of stress relaxation along a parallel oriented and pervasive rock joint set that dips steeply toward the pit, and a large shear zone behind the east wall. This shear zone includes a soft, clay gouge with breccia fragments and has an estimated thickness of 100 feet. Minor raveling has occurred along and from the tension cracks associated with the east shear zone and this necessitated the installation of a rockfall protection fence along the haul ramp along the east highwall.

Southeast Highwall
The southeast pit highwall has experienced planar shear instability since the early stages of mining. Variable size blocks have dislodged from the face and caused raveling of the highwall, which has led to the loss of all the catch benches on this side of the pit. A planar instability, consisting of approximately 4,800 cubic yards of rock, fell from the lower west corner of the southeast highwall to a mining area below in mid-July 2001. This failure is believed to have been the result of both steepening of the adjacent southwest highwall, which relaxed the rock mass in the southwest corner, and precipitation that occurred over a period of several days prior to the instability.

Mining of the open pit was temporarily curtailed on October 14, 2005 due to instable areas on the southeast pit highwall. Mining resumed on March 1, 2007. To increase safety for future mining operations, Montana Tunnels laid back the unstable areas and reduced the highwall slope angle for long-term stability and reestablished new rock fall catch benches beneath insecure areas. Montana Tunnels completed ongoing maintenance and clean up along this side of the pit and has been able to mine safely with proactive monitoring since that time.

Tailings Storage Facility and Embankment

The tailings storage facility and embankment as permitted would cover a total of 267.3 acres (259.3 acres of tailings pond and 8.0 acres of embankment) and are designed to contain approximately 49.1 million cubic yards of tailings. The tailings storage facility embankment was originally approved to an elevation of 5,500 feet, but subsequent permit modifications have increased the elevation to 5,660 feet. As part of the operating permit changes, the embankment design was modified from downstream construction to modified centerline construction.

Since 1987, tailings have been discharged around the edges of the storage facility by a system of header lines with spigots. Coarse solids settle out first to form beaches, and the finer tailings fraction settles toward the center of the tailings storage facility. Direct discharge of tailings to the central area of the storage facility is practiced during the summer and fall months to enhance settlement of the fine tailings. This practice has facilitated a more stable tailings mass suitable for reclamation following the completion of mining.

A waste rock buttress continues to be constructed against the downstream slope of the tailings storage facility embankment to enhance stability (Montana Tunnels 2007). The first phase of the buttress is a compacted fill from the embankment base to the crest elevation. The factor of safety provided by the first phase of the buttress greatly exceeds minimum requirements for embankment stability. Additional filling of the downstream embankment waste rock storage area would further increase embankment stability. A minimum of 19.3 million cubic yards of rock would be stored and the factor of safety would increase as additional rock is added. Under the existing L-Pit closure plan, the reclaimed tailings storage facility surface would drain towards the tailings storage facility embankment, over a rock-lined spillway channel located on the east side of the embankment face, and into the south pond. Run-on control ditches upgradient of the tailings storage facility surface would divert water away from the tailings surface.

Waste Rock Storage Areas

The waste rock storage areas as permitted would cover 425.9 acres and contain approximately 122.3 million cubic yards of waste rock (**Figure 2.2-1**). The primary waste rock storage areas lie to the south and west of the tailings storage facility.

The existing waste rock storage areas were originally designed to be constructed using 50-foot lifts. There have been no waste rock storage area slope stability problems to date.

3.3.3 Environmental Consequences

3.3.3.1 Alternative 1 – No Action Alternative (L-Pit)

Under Alternative 1, work at the mine would continue until the L-Pit reaches a bottom elevation of 4,250 feet. During this period, tailings would continue to be deposited in the tailings storage facility and waste rock would continue to be placed on the waste rock storage areas.

L-Pit

Mining operations would cease after the pit reaches the permitted boundaries of the L-Pit. During this period, pit highwall stability would continue to be monitored using the existing system of survey prisms and extensometers. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and to minimize potential damage to mining equipment.

Some erosion of the L-Pit highwalls and raveling of material onto benches would likely continue during the life of mine. There would be the potential for smaller scale slope failures on pit highwalls and release of rock into the mine pit similar to the failures that have previously occurred during operations.

Upon cessation of mining, pit highwall dewatering wells would be shut down, allowing the pit to begin filling with water. Natural and supplemental inflows into the filling pit would bring the water level to about 5,203 feet during the 5-year closure period. The mine pit would continue to fill with water for almost two centuries and the pit lake surface elevation would reach equilibrium at 5,610 feet, about 60 feet below the rim of the mine pit (see Groundwater Section 3.6 of this EIS). Stability analysis of the northwest highwall towards Clancy Creek concluded that the highwall would not have large-scale failures, would remain stable under full pit flooding conditions, and might not require a buttress (Montana Tunnels 2007).

During the time it takes the mine pit to fill to its final elevation and even after the formation of the pit lake, it is expected that the pit highwalls would ravel onto the remaining benches, forming a slope resembling a naturally occurring talus slope. This raveling would result in the lower portions of the pit highwalls becoming covered with nonacid-generating waste rock. The potential for occasional small-scale slope failures also exists which would potentially affect the safety of animals and humans near the pit rim. To minimize the threat to public safety, the mine pit would be fenced and posted to discourage trespass.

Tailings Storage Facility and Embankment

After mining operations cease, the surface of the tailings storage facility would be dewatered and capped by placing a minimum of 36 inches of nonacid-generating waste rock and 24 inches of soil on the tailings. The final surface of the tailings would have a 0.5-percent to 5-percent slope toward the east end of the embankment to facilitate surface water drainage to the spillway. The capped tailings surface would then be reclaimed by seeding. The outside slope of the tailings storage facility embankment would be reclaimed by reducing the slope to 2.5h:1v. The regraded embankment surface would be covered with 16 inches of soil and seeded. Under Alternative 1, there are no adverse impacts to the tailings storage facility and embankment stability.

Waste Rock Storage Areas

After mining operations cease, the waste rock storage areas would be reclaimed as required by the operating permit. Final waste rock storage area reclamation would include slope reduction from angle-of-repose to 2.5h:1v, application of nonacid-generating cap rock where necessary, placement of 16 inches of soil, construction of drainage diversions, and revegetation. The tops of waste rock storage areas would be essentially flat (less than 2 percent slope). The waste rock storage area tops would be regraded to eliminate depressions and to provide surface water flow away from the steeper side slopes. Shallow drainageways would be created on the waste rock storage area tops to direct flows to undisturbed ground. Where reclamation has been completed on 200 acres of waste rock storage areas, these reclamation practices have been successful, resulting in a stable, well-vegetated top and slopes.

Under Alternative 1, there are no geotechnical adverse impacts to the waste rock storage areas stability.

3.3.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Under Alternative 2, mining would continue until the M-Pit reaches a bottom elevation of 4,050 feet (see **Figure 2.3-1**). During M-Pit mining, tailings would continue to be deposited in the tailings storage facility, and waste rock would continue to be placed on the waste rock storage areas.

M-Pit

For Alternative 2, the M-Pit mining would require the excavation of 46.2 million cubic yards of waste rock and would produce an additional 24 to 28 million tons of ore. The total area of the M-Pit would increase by 39.3 acres to 287.7 acres and would result in the removal of a portion of the Clancy Creek channel along the northwest edge of the

M-Pit. Clancy Creek flow would be diverted into a bypass pipeline, which would convey flow around the expanded mine pit during operations.

The maximum elevation of the pit highwall would increase to 6,450 feet. During M-Pit mining, pit highwall stability would continue to be monitored using an expanded system of survey prisms and extensometers. Mining activities in the pit would continue to be modified as necessary both to ensure worker safety and minimize potential damage to mining equipment.

Some erosion of the M-Pit highwalls and raveling of material onto benches would likely continue during the life of mine. The M-Pit Mine Expansion would expose weaker rock within some of the highwalls resulting in more potential small highwall instability problems.

Upon cessation of mining under Alternative 2, the M-Pit would remain as is with the exception of minor reshaping such as the removal of the haul ramp near the top of the southeast highwall. Pumping of water from the pit would cease, and a portion of the flow in Clancy Creek would be diverted into the pit to accelerate pit lake formation (see Surface Water Section 3.7 of this EIS). Water levels would rise within the pit until the lake reached equilibrium conditions at elevation 5,625 feet about two centuries after mining ceases.

Many factors would influence the predicted post-mining pit lake elevation at equilibrium and the predicted time to fill for each EIS alternative. These factors include differences in pit geometry, surface area, inflows to the pit such as surface runoff and inflow from Clancy Creek, and outflows from the pit such as evaporation and seepage to groundwater. Additional details are provided in Section 3.6 of this EIS.

The M-Pit Mine Expansion would likely expose weaker rock than currently exposed within some of the highwalls. A stability analysis of the proposed expanded mine pit by Knight Piésold concluded that it would be necessary to reduce the overall angle of some parts of the pit highwall to minimize the potential for major highwall instability (Montana Tunnels 2007) (**Table 3.3-1**). Based on these proposed slopes at closure, before filling the pit, the factor of safety for the pit highwall sectors would range from a low of 1.11 (southwest highwall) to a high of 1.33 (east and southeast highwalls). After formation of the pit lake, the factor of safety would increase to a low of 1.34 (southwest highwall) to a high of 1.94 (southeast highwall). A factor of safety of 1.3 is widely accepted for long-term stability of open pit slopes (Montana Tunnels 2007).

TABLE 3.3-1
GEOTECHNICAL STABILITY ASSESSMENT FOR M-PIT MINE EXPANSION
RECOMMENDED HIGHWALL ANGLES

Sector	Existing Overall Angle (Degrees	Sub-Sector	Height, (Feet)	Upper Elevation (Feet msl)	Lower Elevation (Feet msl)	Geology	Recommended Angle (Degrees)		Comments
							Sub-Sector	Overall	
Southwest	50 (2.0h:1v)	SW – Upper		6,400	5,150	Elkhorn Volcanics	40	43 (2.3h:1v)	Extensive groundwater depressurization required within lower diatreme.
		SW – Lower		5,150	4,200	Diatreme	48		
		Overall	2,200						
Northwest	50 (2.0h:1v)	NW – Upper		5,700	5,100	Diatreme	38	48 (2.1h:1v)	Extensive groundwater depressurization required within upper diatreme, includes flattening of upper slope to increase factor of safety and reduce potential for tension cracks.
		NW – Lower		5,100	4,200	Diatreme	53		
		Overall	1,500						
North	39 (2.6h:1v)	N – Upper		6,000	4,800	Lowland Creek Volcanics	45	48 (2.1h:1v)	Steeper upper slope in good quality Lowland Creek Volcanics and steeper overall
		N – Lower		4,800	4,200	Diatreme	49		
		Overall	1,800						
East	38 (2.6h:1v)	E – Upper		5,750	5,100	Lowland Creek Volcanics	36	41 (2.4h:1v)	Weak Lowland Creek Volcanics along upper slope and East Highwall Shear Zone, rockfall protection fences required along haul ramps
		E – Lower		5,100	4,200	Diatreme	46		
		Overall	1,600						
Southeast	38 (2.6h:1v)	S– Upper		5,600	4,700	Diatreme	38	41 (2.4h:1v)	Relocate pit sump, provide extensive depressurization, flatter upper slope for initial pit model (reduce highwall strain and rockfall occurrence)
		SE – Lower		4,700	4,200	Diatreme	48		
		Overall	1,700						

Notes:
1 Maximum allowable overall angles are assumed to include haul ramps.
2 All recommended highwall angles are based on the assumption that controlled blasting would be carried out in all areas.
3 Good depressurization would be established and maintained on all highwalls.
4 Recommended highwall angles based on assumed geological conditions -particularly the location of the northwest highwall Elkhorn Volcanics/Diatreme contact and the north highwall Lowland Creek Volcanics/Diatreme contact.

E	East	msl	Above mean sea level
N	North	NE	Northeast
NW	Northwest	S	South

The proposed M-Pit Mine Expansion would include the relocation of the Clancy Creek channel through a bypass pipeline during mine operation, and diversion of a portion of Clancy Creek flows into the pit after mining ceases.

Similar to Alternative 1, during operations, effective groundwater depressurization would be required and controlled blasting techniques would be utilized in the diatreme in order to maintain the integrity of the benches and minimize raveling to ensure the benches remain capable of containing future rock falls. Based on this analysis, under Alternative 2, there should not be adverse geotechnical impacts in the M-Pit.

For both the L-Pit and M-Pit mine plans, during the time it takes the pit to fill with water to its final elevation (about two centuries), and even after the formation of the pit lake, it is expected that pit highwall surfaces would continue to ravel material onto the remaining benches, forming a talus slope. This raveling would result in the lower portions of the pit highwalls becoming covered with nonacid-generating waste rock. The potential for occasional small-scale slope failure also exists which would potentially affect the safety of animals and humans near the pit rim. To minimize the threat to public safety, the mine pit would be fenced and posted to discourage trespass.

Tailings Storage Facility and Embankment

A waste rock buttress would continue to be constructed as for Alternative 1, up to the crest elevation of the Alternative 2 tailings storage facility embankment as each additional embankment lift is added. Factors of safety provided by the first phase of the buttress completed for Alternative 1 would greatly exceed minimum requirements for embankment stability. Since up to 24.1 million cubic yards of rock would be stored for Alternative 2, the factors of safety would increase as additional rock is added. The additional increase in the factor of safety for Alternative 2 relative to Alternative 1 has not been quantified.

After mining operations cease, the ponded water on the tailings storage facility would be drained or pumped to the south pond and the tailings surface would be capped by placing a minimum of 36 inches of nonacid-generating cap rock and 24 inches of soil on top of the tailings. The final surface of the tailings storage facility would have a 0.5 percent to 5 percent slope toward a drainage ditch located along the west side of the tailings storage facility that would discharge into the mine pit. The capped surface would then be reclaimed by seeding. The outside slope of the tailings storage facility embankment would be reclaimed by reducing the slope from angle of repose to 2.5h:1v. The regraded embankment surface would then be covered with 16 inches of soil and seeded.

Based on this analysis, no adverse geotechnical impacts from the tailings storage facility expansion are anticipated.

Waste Rock Storage Areas

The proposed M-Pit Mine Expansion would require increasing the waste rock storage areas to contain an additional 46.3 million cubic yards of waste rock. As part of this expansion, it would be necessary to strip soil from the reclaimed surface of 147.1 acres of the existing waste rock storage areas.

Waste rock storage area lifts would be increased from 50 feet under the L-Pit design to 150 feet under the M-Pit design. Drainage ditches under the M-Pit design would be constructed at 150-foot vertical intervals instead of 100-foot intervals for the L-Pit design. The finished slope grades of 2.5h:1v would not change from the L-Pit design. A 100-foot-wide berm of nonacid-generating waste rock would be placed on the outer perimeter of each lift. Waste rock with the potential to generate acid would be dumped within this perimeter.

After mining operations cease, the waste rock storage areas would be reclaimed as described in the L-Pit Alternative 1.

Based on past experience with waste rock storage areas, no adverse geotechnical impacts are anticipated.

3.3.3.3 Alternative 3 – Agency Modified Alternative

Instead of using a pipe to divert Clancy Creek as in Alternative 2, Montana Tunnels would construct an open-flow channel to convey flow (up to the 1 in 20 year return period 24 hour storm event) from Clancy Creek around the rim of the mine pit. About 36.9 acres of the hillside above the existing Clancy Creek channel in the vicinity of the mine pit would be laid back at the beginning of the M-Pit Mine Expansion; approximately 4.8 million cubic yards of excavated rock from the layback would be hauled to the waste rock storage area. In addition, waste rock would be placed on the expanded waste rock storage area areas in 50-foot lifts instead of the proposed 150-foot lifts described in Alternative 2.

M-Pit

The Agency Modified Alternative would require that operational and geotechnical measures be implemented to achieve and maintain stability of the relocated Clancy Creek channel. Montana Tunnels has developed a conceptual plan for the construction of the Clancy Creek channel (**Figure 2.4-2**). The channel would be constructed on a 300-foot wide bench. The 50-foot wide channel would be located a minimum of 200 feet from the design pit rim and 50 feet from the toe of the hillside layback. The hillside

above the proposed channel would be laid back at a 2h:1v slope as illustrated on **Figure 3.3-1**.

The hillside setback slope surface would be shaped to appear more natural with a dendritic drainage pattern. Construction of the drainages on the hillside would be from the top down as the hillside is excavated, because of the height and proposed slope of the hillside setback above the channel. This would also reduce unnecessary haul roads. Soil would also be placed and revegetated from the top down.

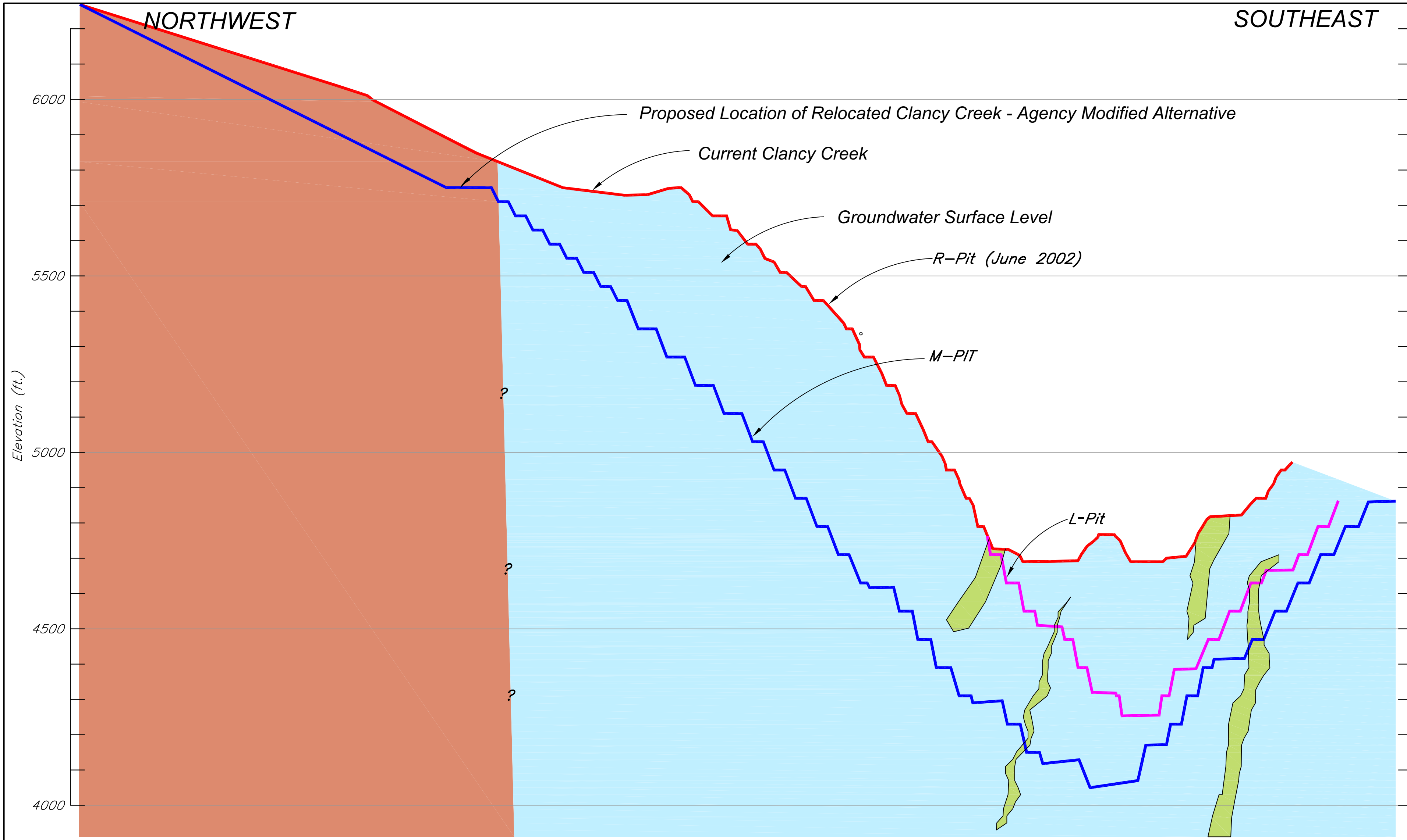
A stability analysis by Knight Piésold of the northwest side of the M-Pit including the relocated Clancy Creek channel concluded that the highwall and channel would be stable as long as the highwall was adequately dewatered and construction of the highwall was completed using good to excellent controlled blasting techniques (Montana Tunnels 2007). **Table 3.3-2** lists the factor of safety for both the overall proposed northwest sector highwall and the hillside setback above the channel for different depths of groundwater depressurization and different levels of controlled blasting. Assuming a minimum groundwater depressurization depth of 100 feet and good to excellent controlled blasting techniques, the factor of safety for the overall slope is estimated to range from a low of 1.34 to a high of 1.67. Assuming a minimum groundwater depressurization depth of 100 feet and good to excellent controlled blasting techniques the factor of safety for the hillside setback is estimated to range from a low of 1.11 to a high of 1.45. Based on this analysis, no adverse geotechnical impacts are anticipated.

Pit highwalls would naturally ravel. The hillside setback above the Clancy Creek channel would not ravel because it would be constructed and reclaimed at a 2h:1v slope. The reshaped slope would be reclaimed by spreading the salvaged soil, revegetating, and constructing controlled drainageways to divert stormwater runoff away from the hillside.

To minimize the threat to public safety, the mine pit would be fenced and posted to discourage trespass.

Tailings Storage Facility and Embankment

The impacts of the Agency Modified Alternative to the tailings storage facility and embankment would be the same as under Alternative 2 -Proposed Action Alternative (M-Pit).



LEGEND

- Elkhorn Volcanics – Ekv
- Diatreme – Tbx
- Volcanic Dike

NOTE:

1. Geological section and groundwater level interpretations provided by Montana Tunnels (Octber, 2005)

Scale 200 0 200 400 600 Feet

FIGURE 3.3-1
Mine Pit Highwall Geologic Section

Montana Tunnels Project

TABLE 3.3-2 STABILITY OF CLANCY CREEK CLOSURE CHANNEL M-PIT NORTHWEST WALL FACTOR OF SAFETY- END OF OPERATION							
Modeling Scenarios	**Blasting Practices**	**Depth of Groundwater Depressurization in Pit Highwall (ft)**					
		0	**50**	**100**	**150**	**200**	**250**
		Factors of Safety					
Upper Slope Stability (above El. 5,000 ft)	Excellent Controlled Blasting (D=0.7)	0.67	1.01	1.24	1.37	1.45	1.45
	Good Controlled Production Blasting (D=0.85)	0.61	0.91	1.11	1.23	1.30	1.30
	Normal Production Blasting (D=1.0)	0.54	0.80	0.97	1.07	1.13	1.13
Overall Slope Stability (Pit Bottom at El. 4,050 ft)	Excellent Controlled Blasting (D=0.7)	0.86	1.22	1.47	1.62	1.66	1.67
	Good Controlled Production Blasting (D=0.85)	0.78	1.15	1.34	1.47	1.50	1.51
	Normal Production Blasting (D=1.0)	0.70	0.98	1.19	1.30	1.33	1.33

Notes:
A 2,340-ft high slope is assumed including the slope above the Clancy Creek diversion ditch for a worst case analysis (Section 9-W).
Rock mass strength derived from Hoek-Brown Criterion
Assumes blasting damage extends 200 feet into the pit highwalls.
Groundwater depressurization incorporates vertical pumping wells and horizontal drainage.
D= refers to a specific ratio of rock mass disturbance. D=0 refers to an undisturbed rock mass and D=1 refers to a disturbed rock mass.

Waste Rock Storage Area

The Agency Modified Alternative would require Montana Tunnels to use a maximum waste rock storage area lift height of 50 feet during construction to improve compaction and facilitate construction of cells to encapsulate acid-generating waste rock. This requirement would not adversely impact the stability of the waste rock storage area due to a projected increase in compaction of the waste rock. This requirement would probably increase the stability in both the short and long term. Montana Tunnels would use a more natural and functional dendritic drainage pattern on the reclaimed waste rock storage area surface, eliminating benches (**Figure 2.4-1**). Waste rock storage areas would be constructed with a concave slope, steeper at the top and less steep at the bottom, to provide a natural looking and functioning system.

3.4 Soil, Vegetation, and Reclamation

The soil affected environment was discussed in the 1986 final EIS on pages III-20, III-24. The impacts to vegetation and reclamation resources from permitting the original Montana Tunnels project were discussed in the 1986 final EIS on pages IV-15 and IV-19.

This section discusses the soil, vegetation, and reclamation resources within the Montana Tunnels Mine study area.

3.4.1 Analysis Methods

Analysis Areas

The analysis area for soils, vegetation, and reclamation includes the L-Pit Plan operating permit area and the areas that would be disturbed by permitting the M-Pit Mine Expansion Plan. The analysis area for sensitive plants and plant communities includes the area within a 10-mile radius of the mine site.

Information Sources - Soils

A mine site soil survey was completed in the proposed project area and was presented in the 1986 final EIS (DSL 1986). Soil mapping was completed at a scale of 1 inch equals 1,500 feet, and included four soil groups including alluvial/colluvial soils, residual volcanic soils, complex soils, and disturbed soils.

Soil resources were surveyed and mapped by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) for Jefferson County from 1987 to 1992, after the mine was operational. Soils were mapped for some areas within the mine permit area, but were not surveyed in the L-Pit and tailings storage facility areas where the soils were already disturbed.

The soil survey data are not available as a published soil survey but are available electronically from the Montana Natural Resource Information System (NRIS) website. In addition, the USDA Forest Service (USFS) has surveyed and electronically published landtype analysis (LTA) resource data for the National Forest System lands adjacent to the mine’s western boundary. The LTA data are not strictly soil survey data but include a general description of soils along with habitat types, landforms, geology, and climate information.

The NRIS website soil and LTA data are comprised of two main components, geographic information systems (GIS) map layers and database files. The GIS map layers are contained in the Soil Survey Geographic and LTA databases and the soils database files are contained in the National Soil Information System database.

Information Sources – Vegetation

A vegetation inventory of the permit area was originally conducted in 1984 (Culwell, Scow and Larsen 1984) with supplemental inventories completed on November 20, 2002, July 1, 2003, and August 5, 2003 (Montana Tunnels 2007). The recent vegetation inventories include mapping of vegetation in the proposed expanded permit area, evaluation of the occurrence of sensitive plant species and sensitive plant communities within the unsurveyed areas, and a discussion of the occurrence of noxious weeds in the expanded permit area. Vegetation survey methods are discussed in Report #12, Vegetation Inventory (Montana Tunnels 2007), which includes supporting documents for the M-Pit Mine Expansion permit application.

Information Sources – Reclamation

A reclamation plan was developed for the L-Pit Plan to stabilize disturbed areas by controlling erosion and reestablishing vegetation types that are ecologically similar to the premine types. An updated reclamation plan was provided for the proposed M-Pit Mine Expansion in 2007 and included information on the postmine topography, soil management, revegetation seed mixtures, and planting methods (Montana Tunnels 2007). The reclamation plan includes premining baseline information obtained from the operating permit area. Reclamation is proposed for all disturbed areas including waste rock storage areas, tailings storage facility, mine pit, haul and access roads, and the facilities areas (**Figure 2.2-4**).

Methods of Analysis

For soils, the acres of soil disturbance were evaluated and compared for each alternative. The volume of soil available to salvage and reuse for reclamation and the quality of the salvaged soil to support post-mining land uses were also analyzed. For vegetation, the acres and types of plant communities disturbed during the mine operations and prior to successful revegetation were evaluated and compared for each alternative. The potential to impact any recorded sensitive plant species or plant community was also analyzed. For reclamation, the potential and probable success of the methods and materials used for reclamation and the ability of the reclamation approach to stabilize the disturbed areas and reestablish vegetation types that are similar to the premine types were evaluated and compared for each alternative.

3.4.2 Affected Environment

3.4.2.1 Soil Resources

The Montana Tunnels Mine is located on hilly to very steep topography consisting of smooth and round to sharp and narrow ridge tops and side slopes. The main geologic parent materials for the Montana Tunnels area soils are the (1) Boulder Batholith (Butte Quartz Monzonite), (2) Elkhorn Mountain Volcanics, and (3) Lowland Creek Volcanics. The regional geologic setting is described in Section 3.2 and in the 1986 final EIS.

The information from the soil surveys was used to identify and evaluate the dominant soil types that occur within the proposed expansion mine area (**Table 3.4-1**). As previously mentioned, the mine predates the soil field mapping efforts; therefore, the mining area was simply mapped as disturbed lands.

TABLE 3.4-1
SOIL UNITS AT MONTANA TUNNELS

Soil Series ID	Soil Series Name	Slope Range	Surface Soil Texture	Percent Rock Fragments
2682	Sawbuck, stony-Yreka, stony-Catgulch complex	15 to 45 %	Very gravelly sandy clay loam	35 - 60
2661	Elve-Cowood complex	45 to 70 %	Very gravelly sandy loam	35 – 60
2681	Sawbuck-Catgulch complex	8 to 45 %	Gravelly sandy loam	15 - 35
1654	Sawicki, stony-Blaincreek-Tolbert complex	15 to 45 %	Very gravelly loam	35 – 60
42	Perma cobbly loam	4 to 15 %	Cobbly loam	15 – 35
1377	Burtoner, very stony-Crampton, bouldery-Catgulch complex	15 to 45 %	Sandy loam	< 15
1287	Clancy, very stony-Crampton, bouldery-Bielenberg complex	15 to 45 %	Sandy loam	< 15
1164	Yreka-Brickner complex	35 to 70 %	Gravelly coarse sandy loam	15 – 35

Soils on slopes over 50 percent generally are considered unsalvageable due to equipment limitations and worker safety. Depth of soil, percent of rock fragments in the soil over 2 mm in size, and soil texture are the main properties used to determine the soil's use in reclamation. It is DEQ's policy that all soils on less than 2h:1v slopes with less than 50 percent rock fragments are considered salvageable.

Soils develop unique properties because of five basic soil forming factors: climate, organisms, parent material, topography, and time (Buol and others 1973). Parent material and topography have dominant influence on the development of soils in the Montana Tunnels Mine area, and understanding the importance of these two factors helps to evaluate potential impacts related to the various alternatives. The main soil parent materials for the mine soils are the Boulder Batholith, Elkhorn Mountain Volcanics, and Lowland Creek Volcanics.

The soils across the mine area have similar surface soil textures, but varying amounts of rock fragments. The sandy loam soils without large amounts of rock fragments (**Table 3.4-1**, Series 1377 and 1287) are more susceptible to water erosion because of their fine textures. Under the current permit, 1,199.5 acres of soils would be disturbed.

3.4.2.2 Vegetation

Based on the expansion area survey, the vegetation type descriptions for the L-Pit Plan operating permit area are relevant to the expansion areas. Vegetation type descriptions, including site descriptions, cover by species, and production data are presented by Culwell, Scow and Larsen (1984). Only common names for plant species are used in the EIS text but scientific names following the 1987 USDA nomenclature are provided for reference in **Appendix C**. The M-Pit Mine Expansion area is dominated by forested and shrub and grassland vegetation communities. Forested communities are primarily Douglas-fir although lodgepole pine can dominate in some stands disturbed by fire, logging, or historical mining activity. Forested types include communities dominated by Douglas-fir and rough fescue, Douglas-fir and common snowberry, and Douglas-fir and pinegrass. Small stands of quaking aspen are present on moist microsites.

Shrub and grassland vegetation types are present as openings within Douglas-fir forest along Clancy Creek and on a broad, sloping bench above Pen Yan Creek. Native grasslands are dominated by various combinations of Idaho fescue, rough fescue, and bluebunch wheatgrass. The vegetation communities are common to west-central Montana as documented in Pfister and others (1977) and Mueggler and Stewart (1980). The two main grassland types are rough fescue and Idaho fescue, and Idaho fescue and bluebunch wheatgrass. Grassland types along Clancy Creek and tributary draws are generally dominated by introduced species including timothy, redtop, smooth brome, and Kentucky bluegrass.

Areas disturbed by historic mining and exploration, road, and power line construction have variable vegetation with older mine disturbances sparsely vegetated. Newer disturbances (exploration roads and power line corridors) have been reclaimed and are grassy openings in the forest.

Sensitive Plant Communities and Sensitive Plant Species

The Montana Natural Heritage Program (MTNHP) did not identify any sensitive plant communities at or within a 10-mile radius of the mine site (Miller 2003). MTNHP identified two sensitive plant species within this same area (Miller 2003). These include:

Musk-root – Three populations of musk-root have been identified in the Basin, Montana area about 10 miles southwest of the mine. This species occurs in drainage bottoms (Miller 2003) and moist woods and rock crevices (Dorn 1984). It is listed as S2 by the state (imperiled because of rarity, or because of other factors making it very vulnerable to extinction throughout its range) and as sensitive by the USFS and BLM.

Peculiar moonwort – Two populations of peculiar moonwort have been identified 2 to 5 miles southwest of the mine. This species occurs on moist grassland slopes (Miller 2003) and moist meadows associated with Engelmann spruce and lodgepole pine forests in the montane and subalpine zones (MTNHP 2004). It is also listed as S2 by the state and as sensitive by the USFS.

Musk-root and peculiar moonwort were not encountered during searches of suitable habitat within the mine expansion area. Likewise, other sensitive plant species listed by MTNHP (2004) were not found in the study area.

Noxious Weeds

Five species listed by Montana as noxious weeds were identified in the expansion area (Montana Department of Agriculture 2006). These include Canada thistle, spotted knapweed, Dalmatian toadflax, houndstongue and yellow toadflax. Canada thistle is sporadic along Clancy Creek with variable cover and was observed along tributary drainages to Clancy Creek.

Spotted knapweed was observed along and adjacent to roads and on historic mine disturbances. Densities are generally low, reflecting ongoing control activities by Montana Tunnels.

Dalmatian toadflax is common throughout the expansion area. It has increased since the original mine baseline inventory 20 years ago when it was recorded only sporadically in grassland and rarely in forested stands (Culwell, Scow, and Larsen

1984). It is now widely distributed throughout grassland and on drier Douglas-fir sites throughout the region and not just the mine area.

Yellow toadflax is not as widespread as Dalmatian toadflax, occurring in both grassland and forested sites. It has increased since the 1984 baseline survey when it was not recorded on any of the 45 sample sites but was noted as an incidental species within the study area. It is also expanding in the region outside the mine area.

Houndstongue is fairly widespread in the M-Pit Mine Expansion area but is generally limited to disturbed areas such as roads and historic mining areas although it also occurs in areas heavily grazed in the past by livestock.

3.4.2.3 Reclamation

Reclamation, including soil salvage and redistribution, and revegetation was discussed in the 1986 final EIS on pages IV-15 through IV-19. The reclamation plan was developed to stabilize disturbed areas by controlling erosion and sedimentation and to meet post-mining land use objectives of restoring aesthetics, recreational, wildlife, and livestock grazing values.

Soils have been salvaged from all disturbed areas except from below soil stockpiles. Through the pre-operational and operational stages of the L-Pit mining and reclamation plans, approximately 2.12 million cubic yards of soil have been salvaged from 1,190 acres. Soil salvage depths have ranged up to 24 inches with the average salvage depth of approximately 13 inches. Most of the salvaged soil remains in stockpiles; however, the 2006 Annual Progress Report states that 205 acres have had soil redistributed and revegetated as part of concurrent reclamation (Montana Tunnels 2007).

Four main habitat community types, encompassing 13 plant community types, were identified during the original baseline vegetation inventory (Culwell, Scow, and Larsen, 1984) and during the July 2004 supplemental vegetation inventory (Montana Tunnels 2007). Four reclamation seed mixtures were developed for the L-Pit in 1986 and revised in 1990. Seed mixtures include native and naturalized grasses, forbs, shrubs, and tree species at rates that approximate 75 total pure live seeds per square foot of drilled acres. Seed mixtures were developed to re-establish (1) grassland, (2) shrub/grassland, (3) Douglas-fir, and (4) aspen plant community types.

Revegetated areas would be evaluated by field reconnaissance during the first season following planting and areas where poor or no germination has occurred would be noted. Revegetation has been successful on the 205 acres that have already been reclaimed. Revegetation monitoring includes assessing canopy coverage and species composition and providing recommendations for future revegetation activities. In 1990 and 1991, WESTECH Environmental Services, Inc. (WESTECH) provided results of the

completed revegetation monitoring which provided for the development of standard operating procedures and best practices for future Montana Tunnels revegetation activities (Montana Tunnels 2007).

Montana Tunnels proposes to establish these four post-mining vegetation types: grassland, shrub/grassland, Douglas-fir, and aspen. The selection of these types was based on the acreage of each type originally planned to be disturbed, site factors following mining (steepness of slope, aspect, soil characteristics, topographic configuration), and post-mining land use objectives.

Montana Tunnels, in cooperation with the agencies, developed seed mixes that were revised in 1990 and 1991 and correspond to the targeted post-mining vegetation types. These seed mixes are proposed in the M-Pit Mine Expansion Alternative (Montana Tunnels 2007). Plant species selection and seed mixes were also based on redistributed soil and substrate properties including texture, rock fragment content, water holding capacity, permeability, erosion hazard, and trace element concentration.

Seed would be obtained from local seed companies. Montana Tunnels would continue to reevaluate each proposed seed mixture prior to planting and, with the concurrence of DEQ and BLM, may modify the mixture to reflect species availability, site differences, and changes in reclamation technology.

3.4.3 Environmental Consequences

3.4.3.1 Alternative 1 – No Action Alternative (L-Pit)

The L-Pit mine results in adverse impacts to soils and vegetation. With successful implementation of the L-Pit reclamation plan, including erosion control procedures, impacts to soils and vegetation would be minimized. According to the Montana Tunnels 2006 Annual Progress Report, Montana Tunnels has successfully reclaimed about 205 acres over the L-Pit plan mine life (Montana Tunnels 2007).

Soil impacts result from the removal, storage, and replacement of soils during mining. Soil has been salvaged from approximately 1,190 acres and would be redistributed over about 959 acres. Approximately 231 acres of the pit disturbance would be reclaimed to rock faces and a pit lake and would not have any redistributed soil. Impacts to soils under Alternative 1 would include loss of soil development and horizons, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of impacts determines in part, the potential success of reclaiming the areas to forested areas, grasslands, and wildlife habitat.

The volume of stockpiled soil is 1.9 million cubic yards, and only 1.7 million cubic yards would be needed for final L-Pit Plan reclamation (Montana Tunnels 2007). The soil stockpile volume is dynamic and changes yearly. The end of year soil stockpile and reclamation soil use volumes are given in annual reports to the agencies (Montana Tunnels 2007).

A large percentage of the soil salvaged and used for concurrent reclamation under the L-Pit Plan contains rock fragment contents ranging from 35 to 60 percent. High rock fragment amounts can be a limiting factor for reclamation due to lower water holding capacities and potentially lower fertility. Beneficial effects of high rock fragment contents in a soil are less erosion, less frost heaving, and less compaction during soil redistribution operations. Reclamation efforts completed to date at the Montana Tunnels Mine do not appear to be limited by high rock fragment content in the soils.

Reclamation of approximately 205 acres of waste rock storage areas has successfully reestablished a grassland vegetation cover. The reclamation seed mixtures contain species that are adapted to the 16 to 24 inches of rocky and well-drained soils that are used to reclaim these sites. Soil erosion and sedimentation occurred from the reclaimed areas during the initial establishment periods, but reclaimed surfaces have stabilized. Specific erosion control procedures are listed in the reclamation plan. Noxious weed infestations are monitored through field reconnaissance and controlled using standard practices, which are summarized in each annual report to the agencies.

Montana Tunnels has not successfully reclaimed any areas to shrub grassland, Douglas-fir, or aspen plant communities. Plantings of conifers have partially survived. The only successful shrub established from seed has been rubber rabbitbrush.

3.4.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Soils and vegetation impacts would be similar to those described under Alternative 1 but would apply to a larger area of disturbance. Soil would be salvaged from an additional 262 acres for a total disturbance of 1,452.2 acres. Soil would be redistributed on an additional 191 acres for a total of approximately 1,150 acres. The pit lake and associated talus slopes or rock faces equaling approximately 288 acres would not require any redistributed soil. The types and degree of impacts to soils and vegetation and to the potential success of restoring the areas to forested areas, grasslands, and wildlife habitat are similar to those for Alternative 1.

The volume of soil salvaged from 262 acres would increase total soil volumes to 2.6 million cubic yards, compared to 1.9 million cubic yards for Alternative 1. A total of 2.2 million cubic yards of soil would be needed to reclaim 1,150 acres. There would be 412,000 cubic yards of excess soil available. This volume of soil (2.2 million cubic yards) would equate to an average of about 14 inches of soil across the reclaimed 1,150 acres.

The thickness of the redistributed soil would range from 8 to 24 inches, depending on the designated reclaimed land use.

The M-Pit Mine Expansion would relocate soil stockpiles that are located within the footprint of the proposed expanded waste rock storage areas. Approximately 0.6 million cubic yards of soil in eight soil stockpiles would need to be either relocated or used for concurrent reclamation. While it is best to not redisturb soil in stockpiles until the soil is ready for redistribution, relocating these soil stockpiles could be accomplished without major impacts to the soil's physical and chemical characteristics, if best management practices (BMP) are used.

The 35- to 60-percent rock fragment content of the additional soil to be salvaged under the M-Pit Mine Expansion is similar to soil salvaged under the L-Pit mine plan. The reclamation efforts completed to date at the Montana Tunnels Mine have been successful and do not appear to be limited by soil rock fragment content.

The revegetation plan for Alternative 2 is nearly identical to the plan for Alternative 1 and it contains the same seed mixtures and the same four plant communities. A new section in the revegetation plan describes the wetlands and Waters of the U.S. in the Clancy Creek drainage. Wetland resources that would be impacted by the proposed mine expansion are discussed in Section 3.8 of this EIS.

3.4.3.3 Alternative 3 – Agency Modified Alternative

The soils and vegetation resources impacted by mining under Alternative 3 would be similar to impacts described under Alternative 2. However, under Alternative 3, the sides of the waste rock storage areas would be regraded with concave slopes and a dendritic drainage pattern. For Alternative 3, Clancy Creek would also be relocated in a constructed open-flow channel, and a wetlands mitigation site would be developed along the creek downstream of the mine pit.

The dendritic drainage pattern and use of more concave regraded slopes on the reclaimed waste rock storage area surfaces implemented under Alternative 3 would help to mitigate and lessen impacts to soils and vegetation and improve reclamation success, compared to Alternatives 1 and 2. The dendritic drainage pattern would be designed and constructed to replace the straight slopes and benches of the waste rock storage areas with a more natural topographic pattern than under Alternative 1 and 2 and would provide more variable slope lengths. Concave slopes are more stable and less susceptible to erosion because the surface water runoff would have less energy and erosional force on the lower slopes where the slope angle becomes less steep. Overall, the incorporation of a dendritic drainage pattern and concave slopes should result in less soil erosion from the reclaimed waste rock storage area surfaces, a more natural

appearance, less need for long-term monitoring and maintenance of slopes, and increased reclamation success.

Relocating Clancy Creek in a constructed open-flow channel would result in additional impacts to soils and vegetation compared to Alternatives 1 and 2, due to the additional disturbance required to lay back the slope to provide the bench for the constructed channel. Soil would be salvaged from the layback slope area (about 36.9 acres) and would be used for reclaiming the final slope face. Stormwater diversion ditches would be constructed just above the regraded layback slope to divert surface water flows away from the reclaimed slope face and minimize soil erosion.

The layback slope above the Clancy Creek channel would be reclaimed at an overall 2h:1v slope, and the agencies would require a dendritic drainage pattern be constructed on the slope as it is built. This would also improve the appearance and reclaimability of the setback slope.

The constructed Clancy Creek channel would be lined to reduce leakage and reclaimed to a small, slightly meandering drainage that would resemble existing conditions along this stretch of Clancy Creek. Placing the channel on a 300-foot-wide bench at least 200 feet from the pit rim would reduce the risk of damage due to raveling and sloughing of the pit highwall.

The constructed open-flow channel for Clancy Creek would flow into the wetlands mitigation area at a slightly higher elevation than the existing Clancy Creek base level. The wetlands mitigation area would cross the entire drainage and the slight increased elevation of the channel inflow to the wetlands should not influence the success of the wetlands mitigation. More information on impacts to wetlands and wetlands mitigation design is provided in Section 3.8.

Noxious weed infestations would be monitored and controlled using standard practices, which are summarized in each annual report to the agencies. The agencies would require Montana Tunnels to aerially seed the upper pit highwalls to help control noxious weeds that would likely invade after mining.

3.5 Geochemistry

This section discusses the geochemistry methods used, the affected environment, and the environmental consequences for Alternatives 1, 2, and 3 as they relate to geochemistry. The discussion focuses on chemical changes occurring when mined materials (i.e. ore, waste rock, and tailings) are exposed to weathering in the surface environment and the potential for resultant release of acidity and metals.

The affected environment for geochemistry at the time of the original 1984 mine permit application was discussed in the 1986 final EIS on page III-15 (DSL 1985). Environmental consequences related to permitting the original Montana Tunnels project were discussed in the 1986 final EIS on page IV-10. The analysis methods for this EIS are summarized below.

3.5.1 Analysis Methods

Analysis Area

The analysis area for geochemistry includes the operating permit boundary, with emphasis on the waste rock storage areas, the tailings storage facility, the mine pit, and the Clancy Creek channel slope layback.

Information Sources

Information for the analysis of geochemical behavior in the Montana Tunnels area was found in the Open Pit Flooding and Water Quality Monitoring Report for Montana Tunnels Mine (Montana Tunnels 2007). Descriptions of tailings testing methodology and results presented in the pit flooding report were provided by Dollhopf (1990). Information and data related to the mine pit and post-mining pit lake water quality were found in technical reports submitted in support of the amendment application and the agencies' deficiency review process (Montana Tunnels 2007).

Methods of Analysis

Geochemical behavior of waste rock and tailings was evaluated based on geochemical testing results and comparison of results to regulatory guidelines, including DEQ-7 water quality standards (DEQ 2006), secondary maximum contaminant levels (SMCLs) for public water supplies (40 CFR Part 143), and existing criteria for evaluating acid-generating behavior (USDI BLM 1996 and U.S. EPA 1994). Operational water quality monitoring data collected for the past 20 years at Montana Tunnels were also considered. Due to the large amount of data and use of a number of test methodologies that pre-date current practices, a detailed technical document was prepared to further

support the analyses and conclusions presented in this EIS (**Appendix B**). This technical document summarizes both static and kinetic tests of acid generation potential, as well as geochemical tests designed to evaluate potential for trace element release. Static tests used to evaluate acid generation potential, such as acid base accounting, involve quantification of the total mass of potentially acid generating and neutralizing minerals through digestion of a finely ground rock flour; as such, they conservatively represent potential for acid generation based on the assumption that all minerals present in a rock are available for reaction. If static tests indicate potential for acid generation, or an uncertain potential, the risk can be evaluated using a kinetic test of the sulfide oxidation rate conducted in a humidity cell. The humidity cell measures change in sulfide oxidation over a period of 20 weeks, typically, and allows evaluation of specific chemical parameters that indicate the extent of acid production, neutralization, and metal release that may accompany weathering. Various geochemical analyses used to develop a model of post mine pit lake water quality, have also been summarized in the technical document. A statistical analysis evaluating whether a significant difference existed with respect to static acid-base accounting results for samples collected at different pit elevations was also conducted, and is provided in **Appendix B.**

3.5.2 Affected Environment

As discussed in Section 3.2 (Geology and Minerals), operations at the Montana Tunnels Mine involve ore recovery from the central portion of a diatreme associated with the Elkhorn and Lowland Creek Volcanics. The Lowland Creek Volcanics are also cut by biotite-bearing quartz latite dikes. Pyrite and sulfide ore minerals, which host gold, silver, lead, and zinc, are distributed within the breccia matrix and as veinlets within the diatreme.

Pit highwall rock, waste rock, and tailings can potentially generate acid and/or mobilize trace metals as they weather. Montana Tunnels has monitored acid generation potential and trace element geochemistry during currently permitted operations (Montana Tunnels 2007). This information, in conjunction with additional data from material proposed to be mined, has been evaluated to characterize the existing geochemical environment in order to predict the potential for geochemical processes to affect water quality.

3.5.2.1 Acid Generation Potential

Waste Rock and Ore

Available data for assessing acid generation potential from Montana Tunnels waste rock and ore include results of static acid-base account testing (ABA), kinetic tests (long-term column leach, bottle roll, and batch reaction tests using tailings reclaim water), and

water quality data from monitoring wells located downgradient of the existing waste rock storage area and tailings storage facility (Montana Tunnels 2007).

Acid-base account testing determines the acidification potential (AP) and immediately available neutralization potential (NP) of a finely ground rock sample (Sobek et al. 1978). AP and NP are reported in units of tons calcium carbonate ($CaCO_3$)/1,000 tons (kiloton) of rock. The ratio of NP to AP values, along with the net neutralization potential (NNP) is used by regulatory agencies to conservatively assess the static acid generation potential of rock samples (**Table 3.5-1)**. NNP is defined as the NP minus the AP.

Samples falling in the "uncertain acid generation potential" category in **Table 3.5-1** require kinetic testing such as ASTM humidity cells or other long-term (*e.g.*, 20 weeks or longer) column leach methods to evaluate the relative rates of acid generation and neutralization, and to help predict the potential for rock to generate acidic leachate over an extended period of weathering.

TABLE 3.5-1
ACID-BASE ACCOUNT CRITERIA FOR CLASSIFYING ACID GENERATION POTENTIAL OF ROCK SAMPLES

Classification	Criteria for Classification[1]
Potentially Acid-Generating	NP:AP < 1 and NNP < -20 tons of $CaCO_3$/kiloton of rock
Uncertain Acid-Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 tons of $CaCO_3$/kiloton of rock
Unlikely to Generate Acid	NP:AP > 3 and NNP > +20 tons of $CaCO_3$/kiloton of rock

Notes:

1	From BLM (1996) and USEPA (1994)
<	Less than
>	Greater than
AP	Acidification potential
$CaCO_3$	Calcium carbonate
NNP	Net neutralization potential
NP	Neutralization potential

ABA testing was completed for 1,875 rock samples collected at Montana Tunnels. Most waste rock samples analyzed for ABA characteristics were separated from ore within ore control blast patterns. The number of holes in a blast pattern typically range from about 100 to 800. Drill holes typically are 6 3/4 inch diameter, 20 feet deep and in rows on 13' to 20' center spacing. Waste rock samples collected in the ore zone would be expected to have greater sulfide content compared to waste rock collected farther away from the mineralized zone.

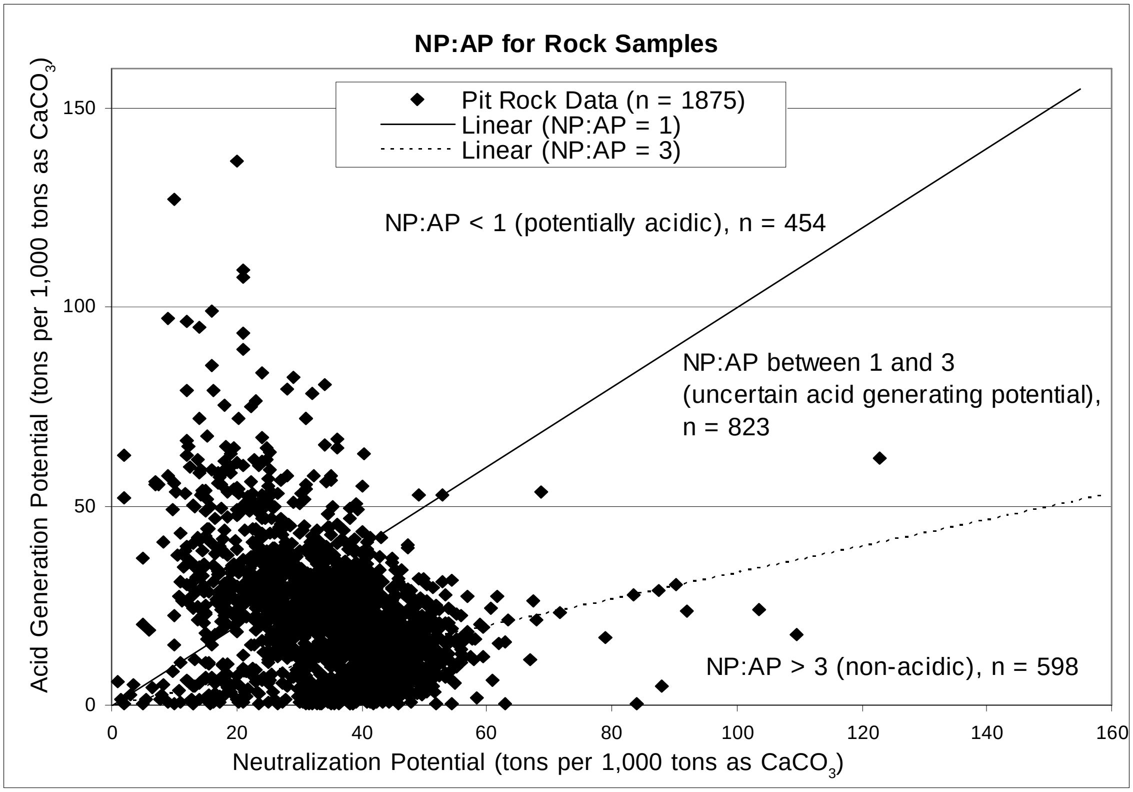
Since 2004, entire ore control blast patterns have been analyzed as a composite of all samples from the holes in the blast pattern to delineate the ABA characteristics of mined rock by bench elevation. Many of these composite samples are mixtures of ore and waste in varying proportions, depending upon the location of the blast pattern. The purpose of this data collection is to provide more comprehensive information to profile the potential ABA characteristics of the pit by elevation on 20-foot bench intervals as mining advances converge into the core ore body at lower elevations.

Based on ABA data, 68 percent of the samples have ratios of NP:AP less than 3. These samples have the potential to generate acid or have uncertain acid-generating potential (**Figure 3.5-1**).

Samples indicated by static ABA testing to be potentially acid producing did not generate acid during kinetic testing (Montana Tunnels 2007 and **Appendix B**), nor has acid rock drainage been observed at the active mine site. Waste and ore samples used in 14-year column leach tests did not produce acidic leachate despite ABA data indicating uncertain or likely acid generation potential. Similarly, samples classified as having uncertain acid-generating potential based on ABA did not generate acid in bottle roll tests.

The nonacid-generating behavior of rock predicted to generate acid based on ABA data has been examined by consultants, universities, and government agencies using a variety of kinetic and other test methods (Montana Tunnels 2007 and **Appendix B**). These studies indicated four reasons for the observed differences in ABA and kinetic test results:

- Montana Tunnels uses an in-house method of ABA testing that minimizes sample reaction with non-carbonate species for NP determinations. Data obtained using this method conservatively understates the concentration of neutralizing minerals and NP in samples relative to analyses completed using the widely accepted Modified Sobek method.
- Montana Tunnels calculate AP based on total sulfur concentrations. Therefore, a portion of the sulfur in Montana Tunnels samples reported as potential acidity is associated with lead and zinc sulfide minerals other than pyrite that do not normally produce acid under oxidizing conditions.
- Rock and tailings samples do not contain submicron-sized grains of pyrite that are easily weathered. Pyrite that is present is larger in size and has less surface area, making it more resistant to weathering. Although the coarsely crystalline pyrite is still able to generate acidity, it is released at a fraction of the rate of submicron grains because much less reactive surface area is exposed per unit mass in the larger grained material. The rate of any potential acid generation at some distant point in time, if neutralization potential were to become depleted, would be very slow.



Legend

<	Less than
>	Greater than
AP	Acidification potential
$CaCO_3$	Calcium carbonate
n	Number of samples
NNP	Net neutralization potential
NP	Neutralization potential

FIGURE 3.5-1
Acid-Base Account Data for
Montana Tunnels Rock Samples

Montana Tunnels Project

- Mine rock contains altered alumino-silicate minerals, such as fine-grained feldspar in the clay-rich breccia matrix, that do not contribute neutralization potential in rapid static tests, but do react slowly to contribute a slow but steady supply of neutralization potential under slower, steady state weathering conditions. Although these minerals are slow to react, the large pyrite grains are also slow to react. The combined neutralization potential contributed by carbonate and alumino-silicate minerals exceeds the amount needed to balance acid potential.

As discussed in Section 3.6 (Groundwater), neutral pH values in groundwater monitored in wells downgradient of waste rock storage areas show no evidence of acidification from leachate infiltrating through the waste rock storage area after 20 years of operation. These water samples to date contain ample concentrations of buffering bicarbonate alkalinity.

Impacts to water resources from acid rock drainage (ARD) and metal concentrations are associated with the nearby historic Minah, Blue Bird, Washington, and Alta mine sites. These mines were developed in wide, sulfide-rich vein systems that geologically predate the Montana Tunnels deposit. Mineralization at Montana Tunnels consists of sulfide mineral disseminations within a feldspar and clay-rich breccia matrix.

Despite the lack of acidification from waste rock previously mined at Montana Tunnels and the conservative nature of static test data for this mineralogical assemblage, **Table 3.5-2** and **Figure 3.5-2** show that NP:AP values decrease with depth in the pit. A statistical analysis (*e.g.*, a one-way analysis of variance [Statistical Package for Social Science, Inc. 1997]), performed on these data confirms that NP:AP decreases with depth are statistically significant and not due to sampling variability (**Appendix B**). The reason for this trend is likely due to a greater amount of sulfide mineralized ore material contained in blast pattern composite samples collected from lower pit elevations due to the geometry of the column shaped ore deposit and the cone shaped design of the mine pit that narrows into the ore body at depth. It is unclear from the available data whether the observed shift toward lower NP:AP values with increasing depth would actually result in acid generation, because there are no supporting kinetic test data which correspond solely to the deeper mineralization.

TABLE 3.5-2 SUMMARY STATISTICS FOR ABA DATA BY DEPTH					
	4,100 – 4,600 feet	4,600 – 5,100 feet	5,100 – 5,600 feet	5,600 – 6,100 feet	6,100+ feet
Number of samples	6	195	901	750	23
NP:AP					
Minimum	0.21	0.12	0.12	0.03	2.85
1st Quartile[1]	0.66	0.39	1.07	1.56	18.72
Median	0.72	0.63	1.72	2.69	60.83
Mean	1.10	1.08	3.79	6.05	69.99
3rd Quartile[2]	0.95	0.95	3.19	4.70	111.34
Maximum	3.25	67.95	280.00	128.33	181.00
Standard Deviation	1.09	4.84	12.44	13.93	57.46

Notes:

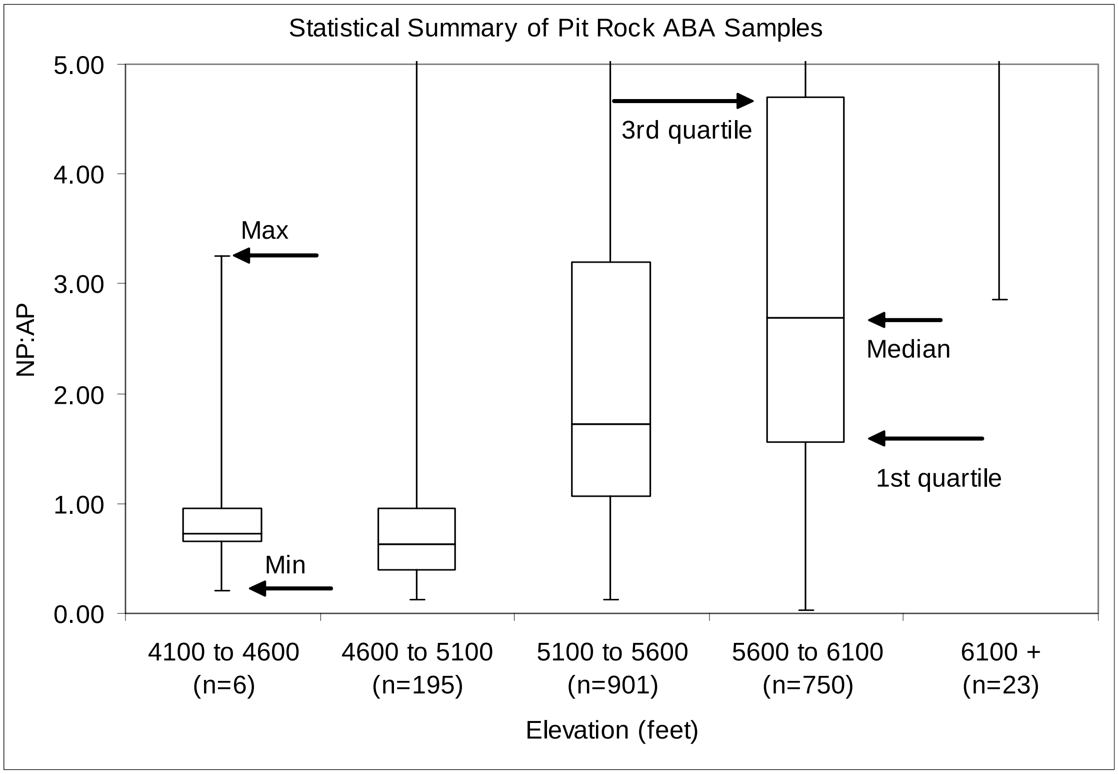
1 1st Quartile is the value below which 25 percent of the data occur.
2 3rd Quartile is the value below which 75 percent of the data occur.
ABA Acid-base account
AP Acidification potential
NP Neutralization potential

Tailings

Geochemical tests were conducted on samples of Montana Tunnels tailings generated through the current milling circuit; conclusions based on these samples include the effects of lime additions or any other processes used during milling.

Acid base accounting data are available for 58 tailings samples. These static test results indicate that the tailings have the potential to generate acid (**Figure 3.5-3**). However, static tests have consistently over-predicted acid generation potential for Montana Tunnels materials and do not generate acid during kinetic testing, as discussed above.

Acid production potential from tailings was assessed using kinetic tests (Montana Tunnels 2007). These tailings samples, predicted by static testing to generate acid, did not become acidic during any of a variety of different kinetic tests. It should be noted, however, that Dollhopf (1990) concluded that coarse-grained pyrite present in tailings samples could eventually weather to yield acidity despite the lack of rapidly weathering submicron-sized pyrite. However, the investigation did not determine if the tailings materials contained any supplemental or latent sources of neutralization potential.



Legend

ABA	Acid-base account
AP	Acidification potential
Max	Maximum
Min	Minimum
n	Number of samples
NP	Neutralization potential

FIGURE 3.5-2
Statistical Summary of Acid-Base Account Data for Pit Rock Samples by Depth

Montana Tunnels Project

As a result of the flotation process, the neutralization potential of tailings is increased through addition of alkaline reagents. Together with naturally occurring neutralizing silicate and carbonate minerals, this alkalinity buffers acid produced through oxidation. Values of pH measured in water samples collected from the tailings storage facility pond, the combined drains, and pore water in the tailings sand are consistently neutral to slightly basic, ranging from 6.60 to 8.15 (**Appendix B**). This demonstrates that neutralization potential is sufficient to balance any acidity generated under present condition. It is unclear whether the observed neutral conditions would continue as tailings consolidation occurs and the tailings dewater, thereby exposing the tailings to higher concentrations of oxygen at closure.

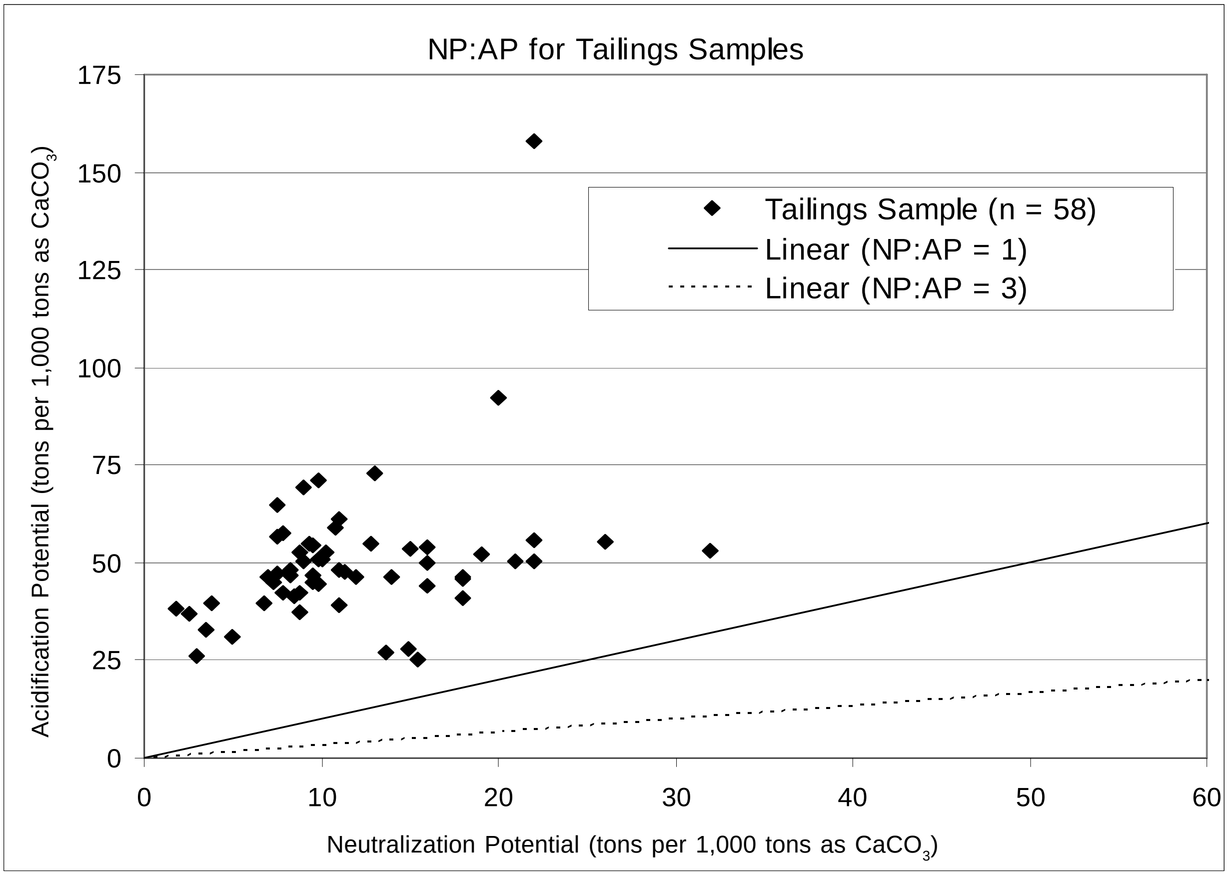
ASTM kinetic testing of a Montana Tunnels tailings sample is in progress with final data expected before January 2008. These data will be incorporated into the final EIS.

3.5.2.2 Trace Metal Mobility

Waste Rock

Kinetic test results for waste rock are summarized in **Table 3.5-3**. Total metals concentrations were measured in extracts collected during 16-hour bottle roll tests and tailings reclaim water interaction tests (**Appendix B**). Mean concentrations of manganese exceeded the SMCL in extracts from most waste rock samples. Arsenic was above the DEQ-7 surface water standard for human health of 0.010 mg/L in all extracts from the biotite-bearing quartz latite dike sample. Extracts from the tailings reclaim water interaction tests generally exhibited water quality that was similar to the reclaim water and exhibited elevated concentrations of the same metals as described for the 16-hour bottle roll test; however, cadmium concentrations were attenuated when tailings reclaim water was equilibrated with any waste rock sample.

Trace metal mobility data were also collected during long-term (*e.g.*, 16 years) column leach tests intended to provide data for assessment of long-term acid production potential. Metal mobility data from the columns are limited to dissolved metal concentrations measured after 9 years of leaching had occurred. The long-term leach test data (**Table 3.5-3**), which show no exceedances of applicable DEQ-7 water quality standards or SMCLs, are useful for predicting long-term steady-state metal release, but are not applicable to predictions of short-term release during mine operations or soon after closure.



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AP	Acidification potential
$CaCO_3$	Calcium carbonate
n	Number of samples
NNP	Net neutralization potential
NP	Neutralization potential

FIGURE 3.5-3
Acid-Base Account Data for
Montana Tunnels Tailing Samples

Montana Tunnels Project

TABLE 3.5-3 WASTE ROCK METAL MOBILITY KINETIC TEST DATA SUMMARY M-PIT MINE EXPANSION												
Rock Type or Column Test (as noted)	**Data Source**	**Sample Type**	**Statistic**	**pH**	**Sulfate**	**Arsenic**	**Cadmium**	**Copper**	**Iron**	**Lead**	**Manganese**	**Zinc**
				s.u.	**Kinetic Test Results Concentrations in mg/L[1]**							
Rock Type: Elkhorn Volcanics	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.1	1.3	0.001	<0.0001	0.005	0.02	NA	0.023	<0.01
			Mean	8.3	4.4	0.002	0.0001	0.011	0.03	NA	**0.057**	0.01
			Maximum	8.5	9.0	0.004	0.0004	**0.027**	0.05	<0.003	**0.108**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	852	0.0007	0.00006	0.0051	0.004	0.0015	0.0022	0.006
			Mean	8.0	855	0.0013	0.00010	0.0079	0.005	0.0024	**0.76**	0.006
			Maximum	8.1	858	0.002	0.00015	0.0131	0.007	0.0036	**1.93**	0.008
Rock Type: Lowland Creek Volcanics	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.0	4.3	0.002	<0.0001	0.001	0.01	NA	0.007	<0.01
			Mean	8.4	7.1	0.003	0.0001	0.006	0.02	NA	0.044	0.01
			Maximum	8.8	17.4	0.003	0.0002	0.012	0.04	<0.003	**0.070**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	7.9	849	0.001	0.00006	0.0072	0.002	0.0016	0.005	0.006
			Mean	7.9	870	0.002	0.00010	0.0091	0.005	0.0061	**0.96**	0.009
			Maximum	8.0	899	0.003	0.00014	0.0122	0.007	**0.011**	**2.45**	0.012
Rock Type: Biotite Dike	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.2	1.7	0.001	0.0001	0.003	0.01	NA	0.019	<0.01
			Mean	8.4	5.3	0.002	0.0002	0.013	0.02	NA	0.034	0.01
			Maximum	8.6	12.8	0.003	0.0004	**0.036**	0.05	<0.003	**0.085**	0.03
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.1	861	0.0004	<0.0001	0.0035	0.006	0.0012	0.003	0.007
			Mean	8.1	868	0.001	0.00005	0.0047	0.006	0.0031	**0.465**	0.008
			Maximum	8.1	872	0.002	0.00008	0.0068	0.007	0.0047	**1.37**	0.01

TABLE 3.5-3
WASTE ROCK METAL MOBILITY KINETIC TEST DATA SUMMARY
M-PIT MINE EXPANSION

Rock Type or Column Test (as noted)	Data Source	Sample Type	Statistic	pH	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Zinc
				s.u.	Kinetic Test Results Concentrations in mg/L[1]							
Rock Type: Biotite-bearing Quartz Latite Dike	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.0	13.0	**0.014**	0.0001	0.002	<0.01	NA	0.027	<0.01
			Mean	8.2	25.7	**0.016**	0.0001	0.006	0.01	NA	0.037	0.01
			Maximum	8.4	60.7	**0.021**	0.0002	0.011	0.01	<0.003	0.044	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	876	**0.015**	0.00004	0.0014	0.002	<0.003	0.003	0.006
			Mean	8.0	878	**0.018**	0.00006	0.0038	0.003	0.007	**0.789**	0.008
			Maximum	8.1	881	**0.022**	0.00009	0.005	0.003	**0.011**	**2.12**	0.011
Rock Type: Diatreme Waste South	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	7.6	11.1	0.004	<0.0001	0.002	<0.01	NA	**0.104**	<0.01
			Mean	8.0	29.6	0.004	0.0001	0.006	0.01	NA	**0.197**	0.01
			Maximum	8.3	75.0	0.005	0.0002	0.014	0.02	0.002	**0.323**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.1	878	0.002	0.0004	0.0026	0.002	0.004	**0.078**	0.021
			Mean	8.2	904	0.003	0.0004	0.0098	0.010	0.006	**1.012**	0.040
			Maximum	8.3	925	0.003	0.0004	**0.0224**	0.022	0.007	**2.88**	0.059
Rock Type: Diatreme Waste North	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.2	9.8	0.001	<0.0001	0.003	0.01	NA	**0.05**	0.01
			Mean	8.3	16.6	0.002	0.0001	0.006	0.03	NA	**0.094**	0.01
			Maximum	8.4	34.5	0.002	0.0002	0.008	0.09	<0.003	**0.155**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	875	0.0009	0.00007	<0.001	0.003	0.0027	0.003	0.018
			Mean	8.1	885	0.0011	0.00011	0.0026	0.008	**0.0097**	**1.39**	0.021
			Maximum	8.2	902	0.0016	0.00014	0.0048	0.017	**0.0187**	**2.69**	0.025

TABLE 3.5-3
WASTE ROCK METAL MOBILITY KINETIC TEST DATA SUMMARY
M-PIT MINE EXPANSION

Rock Type or Column Test (as noted)	Data Source	Sample Type	Statistic	pH	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Zinc
				s.u.	Kinetic Test Results Concentrations in mg/L [1]							
Rock Type: Diatreme Waste rock Storage Area 6	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.1	13.5	0.001	0.0001	0.004	<0.01	NA	**0.08**	0.01
			Mean	8.2	36.4	0.002	0.0001	0.007	0.02	NA	**0.247**	0.02
			Maximum	8.3	105	0.002	0.0002	0.014	0.07	<0.003	**0.477**	0.02
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	796	0.002	0.00006	0.0021	0.003	0.0008	0.006	0.007
			Mean	8.1	856	0.0027	0.00007	0.0048	0.003	**0.0021**	**0.78**	0.008
			Maximum	8.2	888	0.0039	0.00008	0.0084	0.005	**0.0044**	**2.0**	0.01
Colum Test: Column 2 (NAG Dump Perimeter)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.2	15.5	<0.001	<0.0001	<0.001	<0.005	<0.002	<0.005	<0.01
			Mean	8.0	33.6	<0.003	<0.0001	0.002	0.019	<0.003	0.006	0.01
			Maximum	8.4	42.7	<0.003	<0.0001	0.002	0.03	<0.003	0.009	0.01
Colum Test: Column 3 (5630-27 Shot)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.3	56.4	<0.001	<0.0001	<0.001	<0.01	<0.002	<0.005	<0.01
			Mean	7.8	94.7	<0.003	<0.0001	0.002	0.016	<0.003	0.014	0.01
			Maximum	8.1	125	<0.003	<0.0001	0.002	0.03	<0.003	0.026	0.01
Lowest Applicable DEQ-7 Standard or SMCL						0.010[2]	0.0005[3]	0.019[3]	1.0[3]	0.009[3]	0.05[4]	0.24[3]

Notes:
Bold Concentration for test result exceeds DEQ-7 water quality standard or SMCL, as noted.
1 All reported concentrations are total concentrations, except for column tests: column 2 (NAG dump perimeter), and column 3 (5637-20 shot) samples which are reported as dissolved concentrations)
2 DEQ-7 surface water quality standard for human health.
3 DEQ-7 chronic aquatic water quality standard. Based on 230 mg/L hardness (long term average for Spring Creek), where applicable.
4 SMCL
mg/L Milligrams per liter; NAG Nonacid-generating; SMCL Secondary maximum contaminant level
s.u. Standard units; NA Not applicable.
Lead results in original bottle roll tests were biased by cross contamination. Data reported are from a single stage leach used to evaluate lead mobility.
Dump perimeter: The waste rock storage areas are developed with acid-generating material surrounded by nonacid-generating material.

Ore

Kinetic test results for ore are summarized in **Table 3.5-4**. Two long-term column leach test extracts from ore Column #4 exceeded the SMCL for manganese as did one extract from Column #5. No other DEQ-7 water quality standards (or SMCLs) were exceeded during column leach testing, but it should be noted that these data are for dissolved metal concentrations, while DEQ-7 surface water quality standards are based on a total recoverable digestion procedure. Therefore, the potential exists that additional DEQ-7 water quality standards for surface water were exceeded during the test but could not be identified because dissolved analyses typically result in lower concentrations than total recoverable analyses for the same sample.

Bottle roll extracts collected from a single ore sample exhibited total metal concentrations that were near detection limits in all but the first extract, except for manganese. Manganese concentrations increased from 0.3 mg/L in the first extract to 0.6 mg/L in the fifth and sixth (final) extracts.

Concentrations of manganese and iron in extracts from tailings reclaim water interaction tests decreased compared to reclaim water prior to contact with the ore sample. Concentrations of cadmium and zinc increased with increased interaction time between the ore and reclaim water despite low concentrations of these analytes in the 16-hour bottle roll test. Mean concentrations of cadmium, lead, manganese, and zinc were in excess of the respective DEQ-7 standard or SMCL. Data for lead were biased by cross contamination (Montana Tunnels 2007 and **Appendix B**).

Tailings

Test results for tailings are summarized in **Table 3.5-5**. Water quality samples collected from ponded water from the tailings storage facility and from the combined drains provide data for assessing potential metal mobility from tailings solids. Data are also available from testing of pore water in tailings sands and tailings reclaim water used in the milling process (**Appendix B**).

DEQ-7 water quality standards for some metals provided in **Table 3.5-5** are dependent on hardness. As a benchmark, the long-term average hardness for Spring Creek (230 mg/L) was used to calculate hardness-dependent water quality criteria. It should also be noted that DEQ-7 surface water quality standards are based on total recoverable analysis; however, most of the water samples for the tailings storage facility were analyzed using the dissolved portion of the sample after filtration to remove suspended solids. Because ore grinding and discharge of the slurry to the tailings impoundment results in tailings storage facility water containing clays and fine sulfides that settle out over time, sample filtration was deemed appropriate and resulted in less variability and less high bias compared to total recoverable analyses.

TABLE 3.5-4 ORE METAL MOBILITY KINETIC TEST DATA SUMMARY M-PIT MINE EXPANSION												
Rock Type or Column Test (as noted)	**Data Source**	**Number of Samples**	**Statistic**	**pH**	**Sulfate**	**Arsenic**	**Cadmium**	**Copper**	**Iron**	**Lead**	**Manganese**	**Zinc**
				s.u.	**Kinetic Test Result Concentration (mg/L)[1]**							
Rock Type: Diatreme Ore	16-Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	7.8	7.1	<0.003	0.0001	0.004	0.01	<0.003	**0.282**	0.01
			Mean	7.8	22.3	<0.003	0.0001	0.006	0.01	<0.003	**0.450**	0.01
			Maximum	7.9	43.7	0.001	0.0001	0.007	0.02	<0.003	**0.611**	0.02
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	874	<0.003	**0.0013**	0.0004	0.002	**0.036**	0.014	0.231
			Mean	8.0	896	0.0007	**0.0023**	0.0039	0.011	**0.045**	**2.66**	**0.342**
			Maximum	8.2	911	0.0013	**0.0032**	0.0074	0.021	**0.055**	**5.29**	**0.542**
Column Test: Column 1 (5470 Bench)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.5	90.9	<0.001	<0.0001	0.001	<0.005	<0.002	<0.005	0.02
			Mean	7.7	164	<0.003	0.0002	0.002	0.015	<0.003	0.009	0.03
			Maximum	8.0	259	<0.003	0.0002	0.003	0.030	<0.003	0.022	0.04
Column Test: Column 4 (5390 Bench)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.3	57	<0.001	<0.0001	<0.001	0.006	<0.002	0.006	<0.01
			Mean	7.7	144	<0.003	0.0001	0.002	0.009	0.004	**0.059**	0.01
			Maximum	8.2	190	<0.003	0.0001	0.003	0.01	0.007	**0.196**	0.01
Column Test: Column 5 (5690-5 Shot)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.0	52.5	<0.001	0.0001	<0.001	<0.01	<0.003	0.007	0.02
			Mean	7.4	108	<0.003	0.00027	0.002	0.011	0.003	0.046	0.03
			Maximum	7.7	151	<0.003	0.0004	0.003	0.016	0.004	**0.15**	0.04
Column Test: Column 6 (Stock Pile)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.0	121	<0.001	0.0002	0.002	0.007	<0.002	<0.005	0.02
			Mean	7.6	150	<0.003	0.00033	0.005	0.009	<0.003	0.006	0.03
			Maximum	7.9	184	<0.003	0.0004	0.01	<0.01	<0.003	0.012	0.04
Lowest Applicable DEQ-7 Standard or SMCL						0.010[2]	0.0005[3]	0.019[3]	1.0[3]	0.009[3]	0.05[4]	0.24[3]

TABLE 3.5-4 (Cont.)
ORE METAL MOBILITY KINETIC TEST DATA SUMMARY
M-PIT MINE EXPANSION

Notes:

Bold	Concentration for test result exceeds DEQ-7 water quality standard or SMCL
1	All reported concentrations are total concentrations, except for column tests: column 2 (NAG dump perimeter), and column 3 (5637-20 shot) samples which are reported as dissolved concentrations)
2	DEQ-7 surface water quality standard for human health.
3	DEQ-7 chronic aquatic water quality standard. Based on 230 mg/L hardness (long term average for Spring Creek) where applicable.
4	SMCL
mg/L	Milligrams per liter
NAG	Nonacid-generating
SMCL	Secondary maximum contaminant level
s.u.	Standard units

Dump perimeter: The waste rock storage areas are developed with acid-generating material surrounded by nonacid-generating material.

Mean water quality data provided in **Table 3.5-5** for tailings storage facility pond water, underdrain, and embankment drain samples collected from 1993 through 1999 indicate that cadmium, copper, lead, manganese, and cyanide exceeded the lowest applicable DEQ-7 water quality standard or SMCL (Montana Tunnels 2007). Water quality samples from the tailings storage facility pond collected from 2000 through 2004 have lower concentrations compared to samples collected between 1993 and 1999 and exceeded the DEQ-7 standard for cyanide and the SMCL for manganese.

Tailings storage facility embankment and underdrains were combined (thereafter referred to as the "combined drains") in 2002, and six samples were collected since 2002. Mean data from the combined drains show that the DEQ-7 standard for cyanide and the SMCL for iron and manganese are regularly exceeded.

Tailings pore water data are available from a 25-pound sample of tailings sands leached with 4 gallons of mine pit dewatering water (**Table 3.5-5**)(Montana Tunnels 2007). Metal concentrations in dewatering water prior to contact with the tailings sands were below DEQ-7 water quality standards and SMCLs for all measured constituents, except for manganese (0.128 mg/L) which was above the SMCL. Minimum concentrations were measured for all analytes in the extracted sample collected after 2.5 years of contact time, while highest concentrations tended to be observed in the 3 month sample. Mean concentrations were below DEQ-7 water quality standards or SMCLs for all measured constituents except lead and manganese which were above the standard and SMCL, respectively. Additionally, the maximum concentration of arsenic exceeded the DEQ-7 standard.

TABLE 3.5-5
TAILINGS METAL MOBILITY DATA SUMMARY
M-PIT MINE EXPANSION

Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic		Cadmium		Copper		Iron		Lead		Manganese		Zinc		Cyanide	
					Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	WAD
			s.u.	mg/L [1]																
TSF Pond Water Quality Samples (9-22-93 through 4-10-99)	9	Min.	6.18	291	<0.003	<0.003	0.0004	<0.0001	0.011	0.005	0.08	<0.01	0.013	<0.003	**0.298**	**0.198**	0.01	0.1	0.012	<0.0025
		Mean	7.78	635	<0.003	<0.003	**0.0005**	**0.0101**	**0.1025**	0.0339	0.1250	0.0421	**0.0170**	0.0068	**0.8790**	**1.0133**	0.0467	0.161	**0.021**	0.012
		Max.	8.69	866	<0.003	<0.003	**0.0005**	**0.02**	**0.194**	0.1	0.17	0.17	**0.021**	0.01	**1.46**	**2.84**	0.01	0.9	**0.048**	**0.031**
TSF Underdrain Water Quality Samples (2-8-94 through 4-10-99)	45	Min.	6.62	483	0.004	0.0015	0.00005	0.00005	0.0005	0.0015	0.08	0.025	0.0015	0.0015	0.43	**5.77**	0.01	0.01	0.022	0.0025
		Mean	7.03	612	0.007	0.006	**0.006**	**0.0067**	**0.031**	0.033	**2.43**	**0.94**	0.008	0.009	**9.41**	**9.53**	0.13	0.12	**0.399**	0.025
		Max.	7.58	834	0.009	0.009	**0.015**	**0.015**	**0.04**	0.04	**10.5**	**10.1**	**0.01**	0.01	**12.0**	**11.4**	**0.32**	0.3	**0.89**	0.064
TSF Embankment Drain Water Quality Samples (2-8-94 through 4-10-99)	43	Min.	6.85	678	0.0015	0.0015	0.00005	0.0001	0.0005	0.0005	0.005	0.005	0.0015	0.0015	0.08	**0.09**	0.16	0.18	0.0025	NM
		Mean	7.31	774	0.0015	0.0015	**0.005**	**0.006**	**0.030**	0.034	0.12	0.04	0.008	0.009	**0.55**	**0.61**	**0.32**	0.31	**0.008**	NM
		Max.	8.06	868	0.0015	0.0015	**0.015**	**0.015**	**0.04**	0.66	**1.43**	**0.66**	**0.01**	0.01	**2.37**	**2.30**	**0.53**	0.45	**0.04**	NM
TSF Pond Water Quality Samples (8-16-2000 through 8-12-2004)	6 (4 for cyan-ide)	Min.	7.18	376	NA	<0.003	NA	<0.0001	NA	0.002	NA	<0.01	NA	<0.003	NA	**0.559**	NA	<0.01	<0.005	<0.005
		Mean	7.54	585	NA	0.001	NA	0.0004	NA	0.008	NA	0.02	NA	0.004	NA	**1.843**	NA	0.03	**0.016**	0.013
		Max.	7.96	883	NA	0.001	NA	0.0008	NA	0.025	NA	0.08	NA	0.007	NA	**5.51**	NA	0.08	**0.038**	0.028
Combined TSF Drains Water Quality Samples (6-25-02 through 3-3-05)	6 (3 for cyan-ide)	Min.	6.60	565	NA	<0.003	NA	<0.0001	NA	<0.001	NA	**1.07**	NA	<0.003	NA	**3.911**	NA	0.13	**0.024**	<0.005
		Mean	7.09	623	NA	0.005	NA	0.0004	NA	0.005	NA	**1.72**	NA	0.002	NA	**4.495**	NA	0.17	**0.031**	<0.005
		Max.	8.15	670	NA	0.006	NA	0.0006	NA	0.018	NA	**2.62**	NA	0.002	NA	**4.88**	NA	0.18	**0.042**	0.007
Tailings Sands Backfill Pore Water	4 Ex-tracts	Min.	7.71	128	NA	0.005	NA	<0.0001	NA	0.003	NA	<0.01	NA	0.012	NA	**0.258**	NA	0.02	NA	NA
		Mean	7.87	143	NA	0.013	NA	0.0002	NA	0.017	NA	0.04	NA	**0.033**	NA	**0.462**	NA	0.06	NA	NA

TABLE 3.5-5
TAILINGS METAL MOBILITY DATA SUMMARY
M-PIT MINE EXPANSION

Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic		Cadmium		Copper		Iron		Lead		Manganese		Zinc		Cyanide	
					Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	Dis.	Total	WAD
			s.u.	mg/L[1]																
(Column leach extraction with pit dewatering water)		Max.	8.08	160	NA	**0.024**	NA	0.0003	NA	0.027	NA	0.1	NA	**0.044**	NA	**0.619**	NA	0.08	NA	NA
Lowest Applicable DEQ-7 Water Quality Standard or SMCL					0.010[2]	0.010[3]	0.0005[4]	0.005[3]	0.019[4]	1.3[3]	1.0[4]	0.30[5]	0.009[4]	0.015[3]	0.05[5]	0.050[5]	0.24[4]	2.0[3]	0.0052[4]	--
TSF Pond Water Quality Samples (9-22-93 through 4-10-99)	9	Min.	6.18	291	<0.003	<0.003	0.0004	<0.0001	0.011	0.005	0.08	<0.01	0.013	<0.003	**0.298**	**0.198**	0.01	0.1	0.012	<0.0025
		Mean	7.78	635	<0.003	<0.003	**0.0005**	**0.0101**	**0.1025**	0.0339	0.1250	0.0421	**0.0170**	0.0068	**0.8790**	**1.0133**	0.0467	0.161	**0.021**	0.012
		Max.	8.69	866	<0.003	<0.003	**0.0005**	**0.02**	**0.194**	0.1	0.17	0.17	**0.021**	0.01	**1.46**	**2.84**	0.01	0.9	**0.048**	**0.031**
TSF Underdrain Water Quality Samples (2-8-94 through 4-10-99)	45	Min.	6.62	483	0.004	0.0015	0.00005	0.00005	0.0005	0.0015	0.08	0.025	0.0015	0.0015	0.43	**5.77**	0.01	0.01	0.022	0.0025
		Mean	7.03	612	0.007	0.006	**0.006**	**0.0067**	**0.031**	0.033	**2.43**	**0.94**	0.008	0.009	**9.41**	**9.53**	0.13	0.12	**0.399**	0.025
		Max.	7.58	834	0.009	0.009	**0.015**	**0.015**	**0.04**	0.04	**10.5**	**10.1**	**0.01**	0.01	**12.0**	**11.4**	**0.32**	0.3	**0.89**	0.064
TSF Embankment Drain Water Quality Samples (2-8-94 through 4-10-99)	43	Min.	6.85	678	0.0015	0.0015	0.00005	0.0001	0.0005	0.0005	0.005	0.005	0.0015	0.0015	0.08	**0.09**	0.16	0.18	0.0025	NM
		Mean	7.31	774	0.0015	0.0015	**0.005**	**0.006**	**0.030**	0.034	0.12	0.04	0.008	0.009	**0.55**	**0.61**	**0.32**	0.31	**0.008**	NM
		Max.	8.06	868	0.0015	0.0015	**0.015**	**0.015**	**0.04**	0.66	**1.43**	**0.66**	**0.01**	0.01	**2.37**	**2.30**	**0.53**	0.45	**0.04**	NM
TSF Pond Water Quality Samples (8-16-2000 through 8-12-2004)	6 (4 for cyan-ide)	Min.	7.18	376	NA	<0.003	NA	<0.0001	NA	0.002	NA	<0.01	NA	<0.003	NA	**0.559**	NA	<0.01	<0.005	<0.005
		Mean	7.54	585	NA	0.001	NA	0.0004	NA	0.008	NA	0.02	NA	0.004	NA	**1.843**	NA	0.03	**0.016**	0.013
		Max.	7.96	883	NA	0.001	NA	0.0008	NA	0.025	NA	0.08	NA	0.007	NA	**5.51**	NA	0.08	**0.038**	0.028

TABLE 3.5-5
Tailings Metal Mobility Data Summary
M-Pit Mine Expansion

Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic Total	Arsenic Dis.	Cadmium Total	Cadmium Dis.	Copper Total	Copper Dis.	Iron Total	Iron Dis.	Lead Total	Lead Dis.	Manganese Total	Manganese Dis.	Zinc Total	Zinc Dis.	Cyanide Total	Cyanide WAD
			s.u.	mg/L [1]																
Combined TSF Drains Water Quality Samples (6-25-02 through 3-3-05)	6 (3 for cyanide)	Min.	6.60	565	NA	<0.003	NA	<0.0001	NA	<0.001	NA	**1.07**	NA	<0.003	NA	**3.911**	NA	0.13	**0.024**	<0.005
		Mean	7.09	623	NA	0.005	NA	0.0004	NA	0.005	NA	**1.72**	NA	0.002	NA	**4.495**	NA	0.17	**0.031**	<0.005
		Max.	8.15	670	NA	0.006	NA	0.0006	NA	0.018	NA	**2.62**	NA	0.002	NA	**4.88**	NA	0.18	**0.042**	0.007
Tailings Sands Backfill Pore Water (Column leach extraction with pit dewatering water)	4 Extracts	Min.	7.71	128	NA	0.005	NA	<0.0001	NA	0.003	NA	<0.01	NA	0.012	NA	**0.258**	NA	0.02	NA	NA
		Mean	7.87	143	NA	0.013	NA	0.0002	NA	0.017	NA	0.04	NA	**0.033**	NA	**0.462**	NA	0.06	NA	NA
		Max.	8.08	160	NA	**0.024**	NA	0.0003	NA	0.027	NA	0.1	NA	**0.044**	NA	**0.619**	NA	0.08	NA	NA
Lowest Applicable DEQ-7 Water Quality Standard or SMCL					0.010[2]	0.010[3]	0.0005[4]	0.005[3]	0.019[4]	1.3[3]	1.0[4]	0.30[5]	0.009[4]	0.015[3]	0.05[5]	0.050[5]	0.24[4]	2.0[3]	0.0052[4]	--

Notes:

For a given water sample, a dissolved metal concentration should not exceed the total reported concentration of that metal. However, this table does not contain individual results but rather statistical summaries of numerous samples collected over many years. Samples were sometimes analyzed for dissolved metals, sometimes for total metals, and sometimes for both. Also, the detection limits used varied considerably over the years; as a result, statistical analysis of the data sometimes results in dissolved concentrations appearing to be greater than total concentrations.

Bold	Concentration for test result exceeds DEQ-7 water quality standard or SMCL. In cases where total concentrations were not available, dissolved concentrations were evaluated instead.		
1	Reported concentrations are either total or dissolved, as noted		
2	DEQ-7 surface water quality standard for human health.		
3	DEQ-7 groundwater quality standard for human health.		
4	Chronic aquatic water quality standard. Based on 230 mg/L hardness (long term average for Spring Creek), where applicable.		
5	SMCL		
Dis.	Dissolved	mg/L	Milligrams per liter
NA	Not analyzed	NAG	Nonacid-generating
SMCL	Secondary maximum contaminant level		
s.u.	Standard units	TSF	Tailings Storage Facility

3.5.2.3 Pit Highwall Characterization

Characterization of ore and waste rock discussed earlier in this section is applicable to rock exposed in the pit highwall. In particular, 16-hour bottle roll test results are directly applicable, because samples used for this test represented the six major rock types that make up the pit surfaces. Data from that test were used as inputs for a mass loading model to predict water quality in the post-closure pit lake discussed in Section 3.5.3.

Average data for the bottle roll test, percentages of the area covered by each rock type in the pit highwall, and water quality data for the pit sump pond that forms at the bottom of the existing pit and from drawdown wells surrounding the mine pit are presented in **Table 3.5-6**.

The average quality of pit sump water is typical of groundwater near the pit, with additions from pit highwall leachate and contact with the higher sulfide mineralized diatreme of the pit floor. Pit sump water is neutral even though pit sumps always form in the core of the diatreme ore at the bottom of the mine, where the highest sulfide mineralization occurs.

The different geologic units of the mine pit highwalls have been exposed to weathering for many years since mine operations commenced. There is no evidence of iron staining on the walls, acid generation, or metals loading.

3.5.3 Environmental Consequences

3.5.3.1 Alternative 1 – No Action Alternative (L-Pit)

Acid Generation Potential

Waste Rock and Ore

Because the sampling strategy does not distinguish between ore and waste for most samples or the percentage of each that may be contained in a single sample, the behavior of waste rock and ore is assumed to be identical. This is likely to be a worst-case assumption, in that sulfide is more likely to be enriched in association with ore grade mineralization.

TABLE 3.5-6
PIT HIGHWALL CHARACTERIZATION DATA SUMMARY
M-PIT MINE EXPANSION

Parameter	DEQ-7[1]	Pit Sump Avg 1986-2004	Dewatering Wells 1999 Average				16-Hour Bottle Roll Test Average					
			North-West	South-West	East	North Ramp	Diatreme Ore	Diatreme Waste	Lowland Creek Volcanics	Biotite-bearing Quartz Latite Dike	Biotite	Elkhorn Volcanics
Pit Highwall Surface (percent)	NA	NA	NA	NA	NA	NA	19.6	45.4	12.6	5.8	5.9	9.5
	Concentrations in mg/L (Metals data from Dewatering Wells and Pit Sump are dissolved analyses, all other data are for total analyses) pH in standard units											
pH	--	7.7	7.98	7.42	8.06	7.36	7.8	8.2	8.4	8.2	8.4	8.3
Sulfate	250	174	132.3	82.5	105.0	326.2	22.2	27.5	7.1	25.7	5.3	4.4
Arsenic	0.010	0.001	0.007	0.008	<0.003	<0.003	<0.003	<0.003	<0.003	0.016	<0.003	<0.003
Cadmium	0.0005	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0001
Copper	0.019	<0.001	<0.001	0.002	0.003	0.004	0.006	0.006	0.006	0.006	0.013	0.011
Iron	0.05	0.096	0.51	0.09	0.13	0.23	0.01	0.02	0.02	0.02	0.02	0.03
Lead	.009	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese	.05	**0.211**	**0.089**	0.049	0.010	**0.293**	**0.500**	**0.179**	0.04	0.036	0.034	**0.057**
Zinc	.22	0.17	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01	<0.01

Notes:

Bold	Concentration for test result exceeds DEQ-7 standard or SMCL. Reported DEQ-7 water quality standards are based on total concentrations but only dissolved data are available for pit sump and dewatering wells.
1	Lowest Applicable surface water standard reported in DEQ-7. Hardness dependent standards calculated for hardness of 230 mg/L.
mg/L	Milligrams per liter
NA	Not analyzed or not applicable
SMCL	Secondary maximum contaminant level
TSF	Tailings Storage Facility

In spite of static test results suggesting high acid generation potential in samples collected over the past 20 years of operations at Montana Tunnels (**Figure 3.5-1**), acid rock drainage has not developed as a result of L-Pit mining operations. The lack of acid production by existing mine waste rock or ore is consistent with results of water quality monitoring that show no decrease in pH in surface water or groundwater. The lack of acid generation potential from L-Pit waste rock is consistent with kinetic test results.

The potential for acid generation from waste rock and ore is not represented clearly by static test data. This is because the unique mineralogy of the site creates a balance between the rate of sulfide oxidation (i.e., acid production) and neutralization potential, which has prevented the formation of acid rock drainage at Montana Tunnels during the L-Pit Plan, and which also explains the lack of acid production in kinetic tests of rock in spite of acidic static test results.

Montana Tunnels would continue to handle waste rock by identifying zones of sub-ore grade materials with NNP less than 0 tons of $CaCO_3$/kiloton of rock. That material would be placed in interior portions of the waste rock storage area and capped with 25 feet of nonacid-generating cap rock prior to placement of soil and revegetation. If verification sampling shows a dump slope to be acid generating, the slope is covered with an additional 3 feet of nonacid-generating material.

The static test data for rock previously mined below the 5,100-foot elevation, and currently placed in waste rock storage areas suggest that this balance may be altered (i.e., that rock at depth has greater acid potential) (**Figure 3.5-2**), but it is not clear from the available data whether added acid potential would exceed the available neutralization potential enough to alter the critical balance between acid generation and neutralization. Increased sulfide content at depth and increased acid-generating potential are common in ore deposits, due to increased meteoric weathering and oxidation of sulfides that occur in the near-surface environment. It is also likely that these data are influenced by the waste rock sampling strategy and pit geometry, which resulted in a greater amount of mineralized ore material being included in composite samples from below 5,100 feet. Further, the available data do not allow for evaluation of whether the sulfide minerals present in samples collected from below the 5,100-foot elevation are of the same coarse-grained nature observed in samples collected from higher elevations that do not generate acid.

If the increased acid generation potential identified in static test results reflects the limited sampling opportunities at depth within the pit, the risk of acid mine drainage would not increase. Conversely, if more reactive, acid-generating waste rock is encountered and is placed on the top of existing mine rock in waste rock storage areas, the acid generated by new material could trigger faster and more widespread oxidation of the coarse-grained sulfide minerals present in existing tailings and waste rock that currently do not generate acid. This is because of the potential for increase in sulfide

oxidation rates that can result from biotic activity under acidic (< pH 5.5) conditions thereby triggering reactions in previously non-reactive rock. This concern will be addressed through further testing.

Tailings

It is unclear whether tailings, which currently exist in a mostly saturated state, would remain nonacid-generating when they are exposed to greater oxygen concentrations after full consolidation and drain-down, or when tailings derived from ore mined from the L and M pit is placed into the tailings storage facility. Dollhopf (1990) observed no acid generation during kinetic testing of tailings samples collected earlier in mine life but concluded that acid could be produced if the tests were carried out for a period of months to years. Testing of tailings material produced in 2007 from the L pit is current ongoing using ASTM methods to further evaluate the behavior of dewatered tailing.

Montana Tunnels has entered into a custom milling agreement with Elkhorn Goldfields, Inc., whereby ore from the Elkhorn Goldfields Golden Dream project, located 20 miles south of Montana Tunnels, would be milled at Montana Tunnels' existing Diamond Hill milling circuit. The Diamond Hill mill is located within the Montana Tunnels mill complex. In the past, ore from the Diamond Hill Mine near Townsend has been shipped to the mill at Montana Tunnels for processing during operations. It is reasonable to assume that tailings generated from Elkhorn Goldfields ore would be placed into the tailings storage facility at Montana Tunnels but only if geochemical characterization of the Elkhorn Goldfields materials is determined to have no negative affects on the passive nature of the Montana Tunnels tailings materials. The agencies would require Montana Tunnels to apply for a change to its permit and would make the final decision on whether to allow Elkhorn Goldfields material to be processed through the Diamond Hill circuit when full material characterization has been received.

There currently are no data available to assess the behavior of tailings that would be generated from Elkhorn Goldfields ore. It is possible that these tailings would behave differently than has been observed for material currently in the tailings storage facility at Montana Tunnels. In this event, the potential exists for acid-generating material to be placed on the top of existing tailing. As discussed for Alternative 2, acid generated by new material could trigger faster and more widespread oxidation of the coarse-grained sulfide minerals that currently do not generate acid.

Trace Metal Mobility

Waste Rock and Ore

The concentration of manganese in waste rock leachate is expected to exceed the SMCL for manganese (0.05 mg/L). Biotite-bearing quartz latite dike waste material (13 percent of total waste rock by volume) is expected to produce leachate with concentrations of arsenic that are slightly above the DEQ-7 human health standard of

0.010 mg/L; however, the average leachate water quality from all waste rock material would not exceed the DEQ-7 standard for arsenic. Any ore stockpiled during operations could produce leachate similar in quality to that from waste rock. Impacts related to seepage from the waste rock storage area are discussed in Section 3.6 (Groundwater).

Tailings

Tailings have the potential to release concentrations of iron, manganese, and sulfate above DEQ-7 standards or SMCLs. Tailings leachate water would have detectable concentrations of total cyanide (average of combined drains equals 0.031 mg/L). Impacts related to seepage from the tailings storage facility are discussed in Section 3.6 (Groundwater) and Section 3.7 (Surface Water).

After operations cease, tailings would consolidate and drain down, and would be exposed to greater oxygen concentrations. Increased oxidation could result in lower pH values in tailings storage facility seepage and an incremental increase in concentrations of sulfate, iron, copper, and other pH sensitive metals. The magnitude of these changes cannot be quantified with existing data, and would be evaluated through further testing including ongoing humidity cell tests.

Pit Lake Water Quality

As discussed in section 1.8, the 1986 final EIS for the Montana Tunnels project speculated that pit lake water would contain concentrations of iron, manganese, and zinc between 0.5 mg/L and several milligrams per liter. Concentrations of aluminum, cadmium, copper, and lead were expected to range from a few hundredths to a few tenths of a milligram per liter (DSL 1985).

Water quality in the permitted post-closure L-Pit Plan pit lake has more recently been assessed through a mass loading model based on flow rate and chemistry data from sources that would drain into the pit (Montana Tunnels 2007). While the model provides quantitative predictions of water quality, it is an uncalibrated screening level tool, and any conclusions based on the model should be considered qualitative (Anderson and Woessner 1992).

The L-Pit lake model assumes that the pit lake would be dimictic (mixing); however, the geometry of the lake suggests a very high likelihood for the formation of a meromictic (non-mixing) lake (Montana Tunnels 2007). This means that the post-mine pit lake would be stratified with greater metal concentrations at depth and lower concentrations at the surface, compared to concentrations predicted by the pit lake water quality model. This adds an element of conservatism to pit lake water quality predictions of impact to surface water and groundwater resources.

The model considered eight input sources to the L-Pit lake: (1) groundwater inflow, (2) direct precipitation, (3) pit highwall runoff, (4) natural and reclaimed catchment area runoff, (5) the tailings storage facility recovery well system, (6) tailings storage facility pond water (i.e., supernatant), (7) tailings underdrains, and (8) embankment drains. Chemistry inputs for each input source were derived from monitoring data and from geochemical testing (i.e., 16-hour bottle roll) of pit highwall rock samples (Montana Tunnels 2007). The natural and reclaimed catchment area (870 acres) includes the tailings storage facility and portions of the waste rock storage area (about 155 acres), because they would be reclaimed by the time the pit lake begins to fill.

The model predicted that iron and manganese would exceed SMCLs during the period of pit filling (almost two centuries). However, the baseline concentration of iron and manganese in bedrock groundwater in the vicinity of the mine pit also exceeds respective SMCLs. Attenuation of iron and manganese was not included in the model. Sulfate was also predicted to exceed the SMCL for the first few decades of pit filling (See Section 3.6 [Groundwater]).

The impacts associated with seepage from the post-mining pit lake are discussed in Section 3.6 (Groundwater).

3.5.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Acid Generation Potential

Waste Rock and Ore

Under the M-Pit Mine Expansion, about 46.2 million cubic yards of waste rock would be mined during the 5-year extension to mine life. The total volume of waste rock mined from the inception of mining through the end of M-Pit would be 168.5 million cubic yards. Waste rock would include low-grade (sub-ore grade) diatreme, Elkhorn Volcanics, Lowland Creek Volcanics (approximately 10 percent of which consists of biotite-bearing quartz latite dike. The relative volume of each waste rock lithology to be produced throughout mine life is shown in **Table 3.5-7**.

The potential for acid generation and metal release during the M-Pit Mine Expansion is the same as discussed above for Alternative 1 - No Action Alternative (L-Pit). This includes the potential for increased sulfide content at depths below 5,100 feet (**Figure 3.5-2**). The M-Pit Plan includes mining to a pit floor elevation of 4,050 feet. It is likely that these data are influenced by the waste rock sampling strategy and pit geometry, which resulted in a greater amount of mineralized ore material being included in composite samples from below 5,100 feet. The relatively limited number of samples (n=6) of material from below 4,700 feet during the expansion may also influence this interpretation.

TABLE 3.5-7
MONTANA TUNNELS MINE WASTE ROCK VOLUMES PRODUCED THROUGH THE END OF M-PIT MINE EXPANSION

Material	Life-of-Mine Through L-Pit	Life-of-Mine Through M-Pit	Net Change (M-Pit Mine Expansion Only)
	Volume (million cubic yards)		
Low Grade Diatreme	61.4	91.8	30.4
Quartz Latite Dike	18.9	22.9	4.0
Lowland Creek Volcanics (1)	21.5	25.8	4.3
Elkhorn Volcanics	20.5	28.0	7.5
Total	122.3	168.5	46.2

(1) Approximately 10 percent of the volume of Lowland Creek Volcanics is biotite-bearing quartz latite dike material.

Tailings

Because characteristics of Montana Tunnels ore and the milling process would not change, geochemical characteristics of tailings would likely be the same as described for Alternative 1. Water quality impacts from the tailings storage facility are discussed in Section 3.6 (Groundwater) and Section 3.7 (Surface Water).

Metal Mobility

Waste Rock and Ore

Metal mobility from waste rock and ore would be the same as described for Alternative 1.

Tailings

Metal mobility from tailings would be the same as described for Alternative 1.

Pit Lake Water Quality

The mass loading model discussed for the L-Pit Plan was updated with revised inflow volumes for the M-Pit Mine Expansion (Montana Tunnels 2007). Changes to the L-Pit model were necessary to account for combining tailings storage facility underdrains and embankment drains into a single system, discontinuing use of recovery wells, and also to incorporate more recent monitoring data.

The updated model considered seven input sources to the pit lake: 1) groundwater inflow, 2) direct precipitation, 3) pit highwall runoff, 4) natural and reclaimed catchment area runoff, 5) tailings storage facility pond, 6) tailings combined drains, and 7) water diverted from Clancy Creek. The model also considers loss of water from the pit lake due to evaporation and losses to groundwater infiltration on the southeast side of the mine pit when the water elevation exceeds 5,595 feet. Evaporation losses do not result in loss of solute from the pit lake, but groundwater losses do carry a proportionate quantity of solute from the pit lake.

The model does not account for attenuation of metals of potential concern due to oxidation and precipitation mechanisms, co-precipitation of metals such as iron and arsenic in the form of ferric arsenate, or ion exchange/sorption mechanisms of trace elements with solid phases such as clays. Attenuation of manganese is observed in the tailings storage facility when the pond does not receive slurry discharge, and cyanide attenuation is observed during summer months (Montana Tunnels 2007). Cadmium concentrations were attenuated when tailings reclaim water was equilibrated with waste rock samples as discussed in Section 3.5.2.1.

The model predicts that the SMCL for manganese would be exceeded for the entire period of pit filling (about two centuries). The SMCL for sulfate would be exceeded for less than a decade of pit filling, and the DEQ-7 water quality standards for cyanide and cadmium would be exceeded for the first one or two decades of pit filling, respectively after which time dilution from pit inflows would reduce these constituents below applicable standards. Water quality characteristics of the pit lake once it reaches full pool about two centuries in the future are discussed in Section 3.6 (Groundwater) and Section 3.7 (Surface Water).

The model was evaluated for sensitivity to chemistry inputs by 1) representing pit highwall chemistry with the greatest concentrations measured during bottle roll tests, instead of mean concentrations, and 2) replacing mean concentrations for Clancy Creek with maximum concentration data measured in samples collected from the Clancy Creek sampling station in August 2003 and April 2004. Results of the sensitivity analyses for selected years are presented in **Table 3.5-8**. Concentrations predicted using sensitivity analysis scenarios demonstrate little variation from the baseline model. There is an increase in the concentration of manganese, but no DEQ-7 water quality standards for metals or SMCLs are exceeded other than those predicted by the baseline model.

TABLE 3.5-8
COMPARISON OF PREDICTED CONSTITUENT CONCENTRATIONS IN PIT LAKE INCLUDING SENSITIVITY ANALYSIS
M-PIT MINE EXPANSION EIS

Year	Sulfate		Arsenic		Cadmium		Copper		Cyanide		Iron		Manganese	
	Predicted	SMCL	Predicted	Standard	Predicted	Standard	Predicted	Standard	Predicted	Standard	Predicted	SMCL	Predicted	SMCL
Original Model for M-Pit														
1	**341**	250	0.004	0.010	**0.0029**	0.0007	0.012	0.029	**0.0107**	0.0052	0.45	1.0	**1.23**	0.05
5	**252**	250	0.004	0.010	**0.0010**	0.0006	0.007	0.028	**0.0088**	0.0052	0.52	1.0	**1.20**	0.05
10	186	250	0.004	0.010	**0.0006**	0.0006	0.006	0.021	**0.0054**	0.0052	0.38	1.0	**0.78**	0.05
20	141	250	0.004	0.010	0.0004	0.0005	0.006	0.019	0.0032	0.0052	0.29	1.0	**0.48**	0.05
160	96	250	0.004	0.010	0.0002	0.0005	0.006	0.017	0.0007	0.0052	0.18	1.0	**0.14**	0.05
Sensitivity Analysis: Using maximum values from bottle roll test														
1	**344**	250	0.004	0.010	**0.0029**	0.0007	0.013	0.029	No Change		0.45	1.0	**1.24**	0.05
5	**255**	250	0.004	0.010	**0.0010**	0.0006	0.008	0.028			0.52	1.0	**1.21**	0.05
10	190	250	0.004	0.010	**0.0007**	0.0006	0.007	0.021			0.39	1.0	**0.79**	0.05
20	145	250	0.004	0.010	0.0004	0.0005	0.007	0.019			0.29	1.0	**0.50**	0.05
160	100	250	0.005	0.010	0.0002	0.0005	0.008	0.017			0.19	1.0	**0.16**	0.05
Sensitivity Analysis: Using maximum values from bottle roll test and highest values from Clancy Creek Data														
1	**347**	250	0.004	0.010	**0.0029**	0.0007	0.013	0.029	No Change		0.54	1.0	**1.42**	0.05
5	**261**	250	0.004	0.010	**0.0010**	0.0006	0.008	0.028			0.65	1.0	**1.46**	0.05
10	197	250	0.004	0.010	**0.0007**	0.0006	0.007	0.021			0.55	1.0	**1.11**	0.05
20	153	250	0.004	0.010	**0.0005**	0.0005	0.007	0.019			0.49	1.0	**0.88**	0.05
160	113	250	0.005	0.010	0.0002	0.0005	0.008	0.017			0.54	1.0	**0.83**	0.05

Notes:

All concentrations are reported in milligrams per liter.
Bold Concentration exceeds the lowest applicable DEQ-7 water quality standard or secondary maximum contaminant level (SMCL), as applicable.
DEQ-7 water quality standards for cadmium and copper are dependent on hardness, using values of hardness from the pit lake model.

TABLE 3.5-9
ANNUAL PIT LAKE INFLOW BY SOURCE
M-PIT MINE EXPANSION

Year	Pit Highwall Runoff	Natural / Reclaimed Catchment Area Runoff	Clancy Creek Diversion	Groundwater Inflow	Direct Precipitation	TSF Pond	TSF Underdrains
	Percent of total annual inflow volume						
1	12	16	5	19	0	**27**	20
10	23	**36**	12	24	5	0	0
50	20	**39**	13	15	12	0	0
100	17	**41**	13	10	19	0	0
160	0	**47**	15	4	33	0	0

Notes:
Bold Value indicates the highest contributing source for each year.
TSF = Tailings storage facility

Varying the input parameters for concentration as specified in the sensitivity analysis does not greatly affect the predictions of the model. Evaluation of the volumetric contribution from each source shows that the tailings storage facility would contribute the greatest percentage of filling water during the first year but the majority (up to 47 percent) of inflow in subsequent years is contributed by runoff from the reclaimed catchment area (**Table 3.5-9**). Despite elevated metal concentrations in tailings water discussed in Section 3.5.2.2, dilution provided by the low solute natural and reclaimed catchment area runoff reduces the sensitivity of model predictions on the chemistry of the other input terms. Seepage of water from the pit lake at equilibrium is discussed in Section 3.6 (Groundwater).

3.5.3.3 Alternative 3 – Agency Modified Alternative

Geochemical behavior of materials in the study area for Alternative 3 would be the same as described for Alternative 2, although an operational geochemical verification program, an alternative waste rock handling program, and an alternative tailings facility closure plan would mitigate potential adverse effects.

Operational Geochemical Verification Program

The operational geochemical verification program would consist of the following components:

- Montana Tunnels would monitor acid-generating potential, neutralizing potential, and metal mobility of the ore, tailings, and waste rock during operations. Sampling for the waste rock program would be suitable for distinguishing between ore and waste samples and also between specific waste rock lithologies and would include descriptions of rock materials in hand specimens as described in **Appendix D**.

- Additional kinetic testing would be conducted, using standardized ASTM humidity cell testing protocols, of individual waste lithologies that would be mined as waste rock during the M-Pit Mine Expansion (Alternative 2), to evaluate the relative risk of material with more acidic ABA values (**Appendix D**). Tailings samples would also be tested using the ASTM protocol. Also, in light of the possible acceptance of ore for processing from the Elkhorn Goldfields project, additional testing of tailings from Elkhorn Goldfields processing combined with the Montana Tunnels tailings would be conducted, under both saturated and unsaturated conditions to reflect operational and post-draindown conditions.

- Geochemical predictions made in this EIS would be verified based on operational geochemical data and future testing. The pit lake water quality model would be rerun to verify current predictions if operational data change. Likewise, pit sump and pit lake water quality would be periodically monitored to evaluate consistency with the predicted chemistry for the lake.

- Montana Tunnels would monitor tailings leachate water quality for selected geochemical parameters that include but are not limited to cadmium, cyanide, and manganese during the process of tailings consolidation and dewatering and after the 5-year closure period to evaluate the potential for future oxidation of tailings material. Initial monitoring would be conducted annually but this schedule would be adjusted based on the observed quality of tailings leachate and would be discontinued either when DEQ-7 water quality standards are met or when concentrations stabilize.

- To assess potential Clancy Creek water quality issues Montana Tunnels would collect operational geochemical data and conduct static and kinetic testing, if necessary, on geologic material from the layback required to construct the proposed Clancy Creek channel.

Alternative Waste Rock Handling Program

Based on the data collected during the operational geochemical verification program rock as discussed above, Montana Tunnels would handle potentially acid-generating waste by continuing to encapsulate all waste rock with NNP less than 0 tons of $CaCO_3$/kiloton of rock in the waste rock storage area until required additional kinetic testing results of waste material mined from the M-Pit Mine Expansion zone. Selective handling criteria based on these test results must meet timely material handling requirements in the proposed M-Pit mine plan.

As discussed in Section 3.5.2.1, static acid-base account data show more than half of samples to be potentially acid producing; however, these samples do not produce acid during kinetic tests. Therefore, acid-base account data do not provide reliable criteria for separating waste. Considering this limitation, kinetic test results from the operational verification program could be used to delineate zones of potentially acid-generating waste for selective handling and revise the NNP-based handling criterion of 0 tons of $CaCO_3$/kiloton if necessary.

Montana Tunnels would continue to use a waste rock storage area lift height of 50-foot raises during construction to improve compaction and to facilitate construction of cells to suitably encapsulate potentially acid-generating waste. This design would be the same as is currently used successfully, rather than the 150-foot raises proposed for Alternative 2.

Alternative Tailings Storage Facility Closure Plan

Available data from in-situ monitoring and tests of tailings material do not fully address the potential for acid generation following dewatering of the tailings storage facility at Montana Tunnels. This is true not only for material currently permitted for mining in the L-Pit, but also for future production from the M-Pit and tailings produced

from processing of ore shipped from the Elkhorn Goldfields Golden Dream project. Kinetic testing of these materials in the presence of oxygen should be conducted to evaluate the relative sensitivity of these materials, which have clearly acidic static test results but which are sulfide depleted during processing and comprised of the same neutralizing minerals described for waste rock. These tailings would also be amended to increase alkalinity to optimize flotation process chemistry.

Without aerobic kinetic tests that represent the dewatered tailings environment, it is not possible to say how much faster oxidation would occur and how much greater the acidification potential would be. It is certain that oxidation would increase, in the presence of oxygen, so that the products of that oxidation (iron and sulfate) would also increase by some unknown amount. If neutralization potential is exceeded, it is possible that additional acid-soluble elements such as cadmium, lead, and zinc would also increase. The magnitude of potential increase cannot be estimated quantitatively without kinetic test data.

As part of Alternative 3, and as a condition of operations, Montana Tunnels would conduct kinetic oxidation tests to evaluate these possible changes for the existing tailings, for the tailings with M-Pit Mine Expansion material included, and for the tailings with M-Pit combined with Elkhorn Goldfields material. If these tests indicate significant differences from the water chemistry predicted in Section 3.5.2.2 of this EIS, alternative capping strategies for tailings would be considered to limit oxygen flux, neutralize any acidity resulting from oxidation, or reduce seepage. These strategies may include organic amendment (Germain et al. 2000; Pierce 1992; Tasse 2000), addition of lime during final operations to enhance the neutralization potential of the final lift of tailings, or placement of a thicker water balance reclamation cap. As the currently available data do not demonstrate a definitive need for such alternative capping designs, they have not been included as a component of Alternative 3.

Also as part of Alternative 3, if Elkhorn Goldfields tailings are found to generate acid or produce elevated metals concentrations, Montana Tunnels would either refuse to mill Elkhorn Goldfields ore or would apply for an operating permit amendment to construct a separate tailings storage facility to segregate the tailings from material in the existing tailings storage facility.

3.5.3.4 Summary

Waste rock and ore mined under the L-Pit and M-Pit plans are expected to behave similarly. Static ABA testing suggests the potential for acid generation exists, especially at depths below 5,100 feet. However, these data are conservative as shown by kinetic tests that consistently fail to produce acid from samples classified as acidic based on ABA data. Acid generation is not expected, but the possibility for rock encountered at

depth to produce acid will be further evaluated through an operational verification plan including a more detailed sampling plan and kinetic tests as described in **Appendix D**.

The L-Pit lake is predicted to have elevated concentrations of iron and sulfate for the first few decades after pit filling begins, and manganese is predicted to exceed the SMCL for about two centuries. The M-Pit lake is predicted to have elevated concentrations of cadmium, sulfate, and cyanide for about one to two decades and manganese is predicted to exceed the SMCL for about two centuries. Potential impacts to water resources are discussed in Section 3.6 (Groundwater) and Section 3.7 (Surface Water).

As discussed in Section 3.6, groundwater quality data and results from analysis of impacts were evaluated against existing groundwater quality standards contained in DEQ-7 (DEQ 2006a). When no groundwater standards for a specific parameter were listed in DEQ-7, such as iron and manganese, then the data were evaluated against SMCLs promulgated by EPA for public water supplies in 40 CFR Part 143.3.

For iron and manganese, DEQ-7 authorizes DEQ to use the SMCLs as guidance to ensure that beneficial uses of the groundwater are protected. In addition, under ARM 17.30.1006(b), DEQ may use the SMCLs for iron and manganese to prohibit "any increase of a parameter to a level that renders the waters harmful, detrimental, or injurious" to the beneficial uses of groundwater. Since the data indicate that the SMCLs for iron and manganese are already exceeded in the groundwater, this information indicates that any increase above existing levels may impact the use of the groundwater as a drinking water supply.

3.6 Groundwater

This section discusses the groundwater analysis methods used, the affected environment under 2007 conditions, and the environmental consequences for Alternatives 1, 2, and 3 as they relate to groundwater hydrology.

The affected environment for groundwater at the time of the original 1984 mine permit application was discussed in the 1986 final EIS on page III-13. Environmental consequences related to permitting the original Montana Tunnels project were discussed in the 1986 final EIS on page IV-4. The analysis methods for this EIS are summarized below.

3.6.1 Analysis Methods

Analysis Area

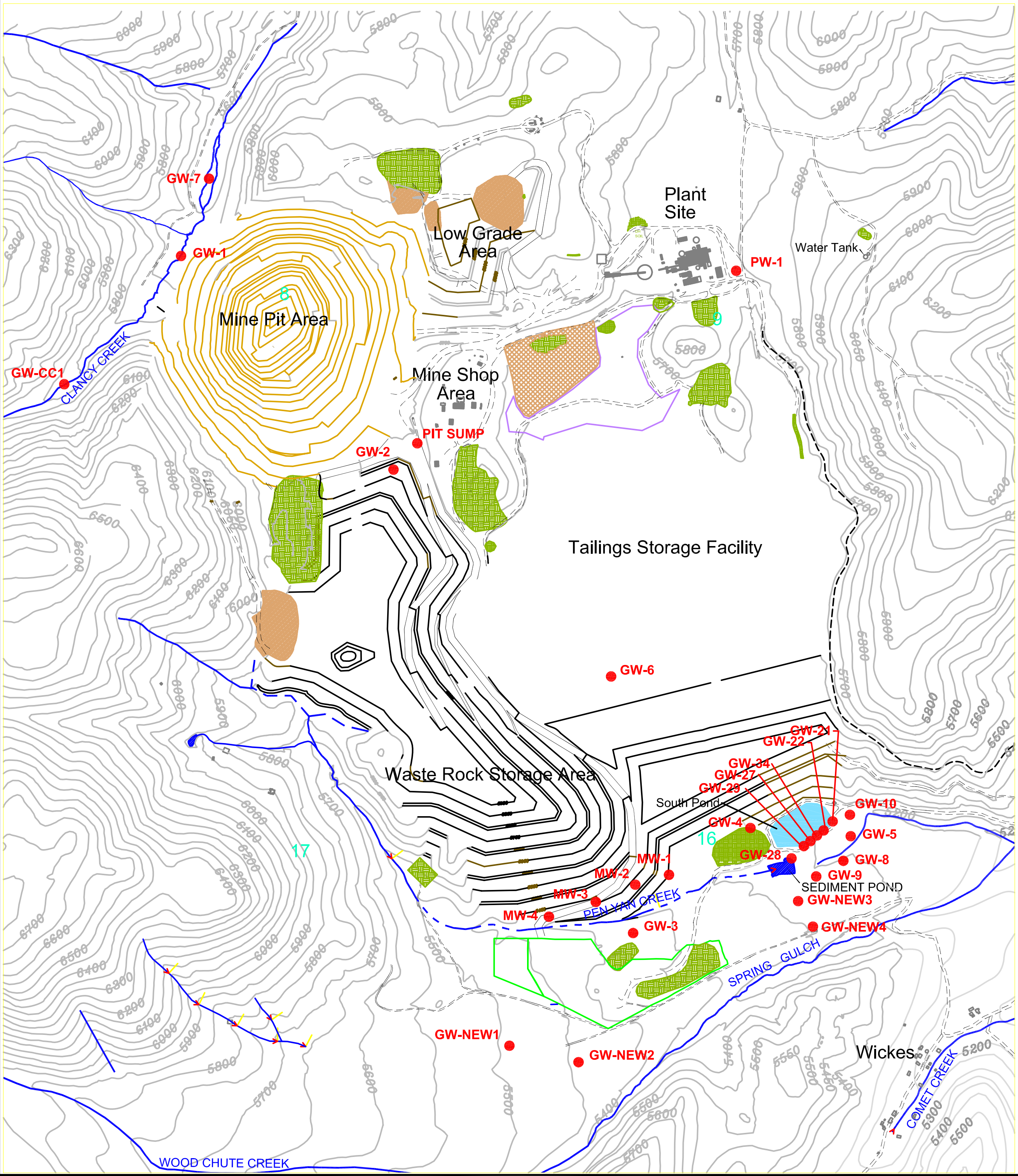
The analysis area for groundwater resources includes unconsolidated valley-fill deposits (alluvium and colluvium) and saturated bedrock in the Pen Yan, Homestake, Wood Chute, Spring Creek, and Clancy Creek drainages within and adjacent to the mine permit boundary (**Figure 3.6-1**).

Information Sources

Information for the analysis of groundwater resources in the Montana Tunnels area was found in the application for amendment to Montana Tunnels Operating Permit 00113 and related technical reports contained therein (Montana Tunnels 2007). Groundwater quality standards were obtained from DEQ publication DEQ-7 (DEQ 2006a). SMCLs for public water supply systems were obtained from 40 CFR Part 143.3. Recent hydrogeologic data collected as part of the application for permit amendment were cross-checked with information provided in the 1986 final EIS (DSL 1986).

Methods of Analysis

Groundwater flow and quality were analyzed using standard groundwater flow equations and hydrogeologic water-balance relationships (Todd 1991). Potential groundwater quality impacts related to the mine area and post-mining pit lake, tailings storage facility, and waste rock storage areas were estimated for the Spring Creek drainage at a location represented by monitoring well GW-5 (**Figure 3.6-1**). Monitoring well GW-5 is the most representative downgradient monitoring well location because it is located downgradient of the mine pit, tailings storage facility, and portions of the waste rock storage areas, and upgradient of the mine permit boundary in Spring Gulch.



LEGEND

- Existing Soil and or Gravel Stockpile
- Cap Rock Stockpile
- Monitoring Well Location

N

500 0 1500
Feet
Source: Apollo Gold, Inc.

Notes: Figure shows existing and newly proposed monitoring wells for Alternatives 1 (L-Pit) and 2 (M-Pit).
Surface configuration is for Aletrnative 1 - No Action Alternative (L-Pit).
All Monitoring well locations are shown.

FIGURE 3.6-1
Monitoring Well Locations

Montana Tunnels Project

The period of record for monitoring well GW-5 is also the most comprehensive, as it includes baseline data collected in 1984 prior to beginning mining at Montana Tunnels, and additional operational data collected from that point until 2007.

Water-balance models were constructed by Montana Tunnels (and verified by the agencies) to estimate the filling time for various pit configurations and alternatives, and to predict the water quality characteristics of the post-mining pit lake (Montana Tunnels 2007). Water-balance models are not currently calibrated (calibration is a check to ensure a model provides valid predictions for future conditions) , but could be calibrated (at a future point in time) once mining ceases and pit lake elevation data and pit lake water quality data are collected in the future. The existing uncalibrated water-balance models should be considered screening tools that provide quantitative results to support conclusions qualitatively.

Groundwater mixing models were constructed by the agencies that used hydrogeologic water-balance relationships and assumed instantaneous and complete mixing of seepage flows into groundwater. The models do not account for natural attenuation processes which can remove some metals from groundwater under certain conditions. The mixing models calculated impacts to groundwater in terms of the incremental change in concentration for the time period of interest. For these models, all less than detection limit concentrations were set equal to one-half the detection limit value. The groundwater mixing models are screening level tools that provide quantitative output (percent increase or decrease in the concentrations of contaminants) that should be used to support qualitative conclusions. The percent change in the concentration of a constituent could not be predicted for cases where the baseline concentration of a constituent was less than the laboratory detection limit value.

Flow rates for all analyses are presented in units of both gallons per minute (gpm) and cubic feet per second (cfs). All concentrations are presented in units of milligrams per liter (mg/L).

Groundwater quality data and results from analysis of impacts were evaluated against existing groundwater quality standards contained in DEQ-7 (DEQ 2006a). When no groundwater standards for a specific parameter were listed in DEQ-7, such as iron and manganese, then the data were evaluated against SMCLs promulgated by EPA for public water supplies in 40 CFR Part 143.3.

For iron and manganese, DEQ-7 authorizes DEQ to use the SMCLs as guidance to ensure that beneficial uses of the groundwater are protected. In addition, under ARM 17.30.1006(b), DEQ may use the SMCLs for iron and manganese to prohibit “any increase of a parameter to a level that renders the waters harmful, detrimental, or injurious” to the beneficial uses of groundwater. Since the data indicate that the SMCLs for iron and manganese are already exceeded in the groundwater, this

information indicates that any increase above existing levels may impact the use of the groundwater as a drinking water supply.

An adverse impact for groundwater analyses is defined as an impact that reduces available groundwater flow that would alternatively provide water for another potential beneficial use; or an impact that increases the concentration of a constituent in groundwater above the DEQ-7 groundwater standard. A beneficial impact is defined as an impact that increases available groundwater flow, or that decreases the concentration of constituents in groundwater thus improving some aspect of water quantity or quality.

A short-term impact is defined as an impact that would last no longer than the end of the 5-year closure period. A long-term impact is defined as an impact that would persist beyond the 5-year closure period.

3.6.2 Affected Environment

Groundwater in the study area flows in unconsolidated valley-fill deposits (alluvium and colluvium), and to a lesser extent in underlying bedrock fractures.

Unconsolidated valley-fill deposits in the Pen Yan, Wood Chute, Spring Creek, and Clancy Creek drainages consist of recent alluvium (silty sand and gravel) and poorly-sorted colluvial and outwash or fan-type deposits. The valley bottom flats area to the south of the main waste rock storage area and tailings storage facility contains glacial outwash colluvium. These unconsolidated deposits are up to 150 feet thick at monitoring wells GW-8 and GW-9 near the confluence of Homestake Gulch, Pen Yan Creek and Spring Gulch (**Figure 3.6-1**). The tailings storage facility is built over Homestake Gulch; the gulch does not appear on figures in this EIS.

Clancy Creek alluvium in the vicinity of the mine site consists of about 35 feet of gravel and sand saturated below a depth of about 10 feet beneath ground surface. Spring Creek alluvium downstream of the mine permit boundary consists of up to 60 feet of sand and gravel (DSL 1985). Groundwater moves down-valley in these unconsolidated deposits, some of which may discharge to surface water or infiltrate into the underlying bedrock fracture systems.

Bedrock in the study area consists of granitic rocks of the Boulder Batholith, volcanic rocks (Elkhorn and Lowland Creek Volcanics), and a diatreme that fills a volcanic vent in the mine pit area. Bedrock below valley-fill deposits downgradient from the tailings storage facility is predominantly volcaniclastic rock of the Lowland Creek Volcanics (Montana Tunnels 2004). Depth to bedrock along the line of recovery wells

downgradient from the south pond ranges from about 60 feet at monitoring well GW-21 to 120 feet at monitoring well GW-27 (Montana Tunnels 2007)(**Figure 3.6-1**).

Groundwater Flow Systems

Groundwater in the study area generally follows topography with flow from upland recharge areas to valley bottom discharge areas. Near the mine pit, groundwater in bedrock generally moves from the northwest to the southeast towards the Spring Creek drainage (Montana Tunnels 2007). To the north of the mine area, groundwater in bedrock and alluvium generally moves north along the Clancy Creek drainage. Groundwater movement in bedrock in the study area is slow and primarily controlled by zones of interconnected fractures. The bedrock aquifer is generally not very productive relative to other sources of mine water. Some stream reaches also may be recharged by alluvial groundwater. Several major springs discharge water from bedrock to Spring Creek approximately 2.5 miles east of the mine site.

Dewatering activities in the mine pit result in a continuous flow of groundwater from bedrock in the vicinity of the pit highwalls into the pit. Because the mine pit is constantly being dewatered during active mining, the pit acts as a groundwater "sink" (similar to a large well). Maximum groundwater drawdown near the mine pit is currently over 1,000 feet; however, the amount of drawdown decreases exponentially further away from the pit and is not measurable 0.5 mile from the center of the pit (Montana Tunnels 2007).

Depths to groundwater in most of the study area monitoring wells have shown little variability over the 20 years of monitoring, even through periods of below average precipitation (Montana Tunnels 2004). An exception is one monitoring well (GW-7), completed in Clancy Creek alluvium adjacent to the mine pit (**Figure 3.6-1**). This monitoring well exhibits relatively high seasonal fluctuations in water levels. Depth to groundwater in Clancy Creek alluvium in the mine area is about 10 feet below the stream bottom indicating the stream is perched. Downstream of the mine pit, Clancy Creek loses flow indicating that some surface water infiltrates into the underlying alluvium and groundwater.

The former water supply well (PW-1) completed in bedrock east of the mill facility reportedly yields about 30 gpm (0.07 cfs), but not on a sustained basis. This indicates that some areas of fractured bedrock in the general study area can yield moderate quantities of groundwater to wells.

Monitoring Well Network

Groundwater data were collected from several monitoring wells (GW-1 through GW-7) during the 1984 to 1985 premining baseline period of measurement. Not all of the

original monitoring wells are still operational. Some have been destroyed by excavation of the mine pit and construction of the tailings storage facility and waste rock storage areas.

Montana Tunnels continued to collect additional groundwater data from existing monitoring wells and other wells constructed from 1986 to 2007. In addition, the water resources monitoring plan was revised in 1998, with concurrence from DEQ, after existing data were evaluated. Specifically, the number of monitoring wells, analytical schedule, and quarterly reporting requirements were modified to better focus the monitoring effort.

A summary of monitoring wells that have been included in the groundwater monitoring program in the past, and possible future well locations for the Montana Tunnels project, is provided in **Table 3.6-1**. Well completion data are provided in **Table 3.6-2**. The water quality monitoring program described below would not be static or inflexible. The program would remain flexible enough to respond to data trends, changes in informational requirements and site specific situations.

Groundwater monitoring wells currently used for the Montana Tunnels monitoring program can be grouped into five general categories (**Figure 3.6-1**):

- Ten wells constructed downgradient from the tailings storage facility and associated water ponds: GW-5, GW-8, GW-9, GW-10, GW-21, GW-22, GW-27, GW-28, GW-29, and GW-34. Groundwater elevation and water quality data from these monitoring wells are used to evaluate potential impacts from the tailings storage facility to the alluvium and shallow bedrock aquifer, and some are part of the recovery well system and are periodically pumped when additional makeup water for the mill is required.
- Five monitoring wells constructed downgradient of the waste rock storage areas: GW-3, MW-1, MW-2, MW-3, and MW-4. Groundwater elevation and water quality data from these monitoring wells are used to evaluate potential impacts to alluvial groundwater associated with seepage from the waste rock storage areas.
- One monitoring well constructed in Clancy Creek alluvium: GW-7. Groundwater elevation data from this well are used to evaluate potential effects of mine pit dewatering.
- One monitoring well completed in bedrock east of the mill facilities: PW-1. Groundwater elevation and water quality data from this well are used to evaluate potential impacts to groundwater in the vicinity of Montana Tunnels mill facility.
- Mine pit inflow water (Pit Sump) sampled from the dewatering pond on the upper east side of the mine pit or directly from pit dewatering wells.

TABLE 3.6-1
GROUNDWATER MONITORING PROGRAM

Well No.	Location	Lithology	Year Installed	Quarterly Monitoring Events			
				1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
GW-1[a]	Northwest of Mine Pit in Clancy Creek Drainage	Bedrock	1984; destroyed in 1998	WL	C	WL	WL
GW-2[a]	SE of Mine Pit	Bedrock	1984	WL	C	WL	WL
GW-3	Downgradient (Southeast) of Waste Rock Storage Area in Pen Yan Creek Drainage	Bedrock	1984	WL	C	WL	WL
GW-4[a]	At Tailings Dam in Homestake Gulch Drainage	Alluvium	1984	WL	C	WL	WL
GW-5	Downgradient of Tailings Storage Facility near Confluence of Homestake Gulch & Pen Yan Creek	Alluvium-Bedrock	1984	C	C	C	C
GW-6[a]	Near Tailings Storage Facility Embankment	Alluvium	1984	WL	C	WL	WL
GW-7	North of GW-1 and Mine Pit in Clancy Creek Drainage	Alluvium	1984	WL	WL	WL	WL
GW-8	Downgradient of South Pond South of Pen Yan Creek	Alluvium	1986	C	C	C	C
GW-9	Downgradient of Tailings Storage Facility South of Pen Yan Creek	Alluvium	1986	C	C	C	C
GW-10	Downgradient of Sedimentation Pond in Homestake Gulch Drainage	Alluvium-Bedrock	1986	C	C	C	C
PW-1	Former Water Supply Well	Bedrock	1986	WL	C	WL	WL
GW-21	Recovery Well Southeast of South Pond	Alluvium-Bedrock	1987	WL	C	WL	WL
GW-22	Recovery Well Southeast of South Pond	Alluvium-Bedrock	1987	WL	C	WL	WL
GW-27	Recovery Well Southwest of South Pond	Alluvium-Bedrock	1987	WL	C	WL	WL
GW-28	Recovery Well Southwest of South Pond	Alluvium-Bedrock	1987	WL	C	WL	WL
GW-29	Recovery Well Southwest of South Pond	Alluvium-Bedrock	1987	WL	C	WL	WL
GW-34	Recovery Well South of South Pond	Alluvium-Bedrock	1987	C_{ex}	C	C_{ex}	C
MW-1[a]	East Well Between Waste Rock Storage Area Toe and Pen Yan Creek	Alluvium-Bedrock	1993	WL	C	WL	WL

TABLE 3.6-1
GROUNDWATER MONITORING PROGRAM

Well No.	Location	Lithology	Year Installed	Quarterly Monitoring Events 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
MW-2 [a]	East Middle Well Between Waste Rock Storage Area Toe and Pen Yan Creek	Alluvium-Bedrock	1993	WL	C	WL	WL
MW-3 [a]	West-Middle Well Between Waste Rock Storage Area Toe and Pen Yan Creek	Alluvium-Bedrock	1993	WL	C	WL	WL
MW-4 [a]	West Well Between Waste Rock Storage Area Toe and Pen Yan Creek	Alluvium-Bedrock	1993	WL	C	WL	WL
GW-40	Recovery Well South of South Pond	Mostly Bedrock	2003	WL	WL	WL	WL
GW-41	Recovery Well South of South Pond	Mostly Bedrock	2003	WL	WL	WL	WL
GW-42	Recovery Well South of South Pond	Mostly Bedrock	2003	WL	WL	WL	WL
Pit Sump	Pit Dewatering Collection Pond at Upper East Side of Mine Pit	Pit Water	---	---	C	C	C
NEWLY PROPOSED MONITORING WELLS (FOR ALTERNATIVES 2 and 3)							
GW-New1	Well Upgradient of Waste Rock Storage Area Extension Northwest	Alluvium-Bedrock	Future	WL	C	C	WL
GW-New2	Well Upgradient of Waste Rock Storage Area Extension Southwest	Alluvium-Bedrock	Future	WL	C	C	WL
GW-New3	Well Downgradient of Waste Rock Storage Area Extension North	Alluvium-Bedrock	Future	C	C	C	C
GW-New4	Well Downgradient of Waste Rock Storage Area Extension South	Alluvium-Bedrock	Future	C	C	C	C
GW-CC1	Well Upgradient of Mine Pit in Clancy Creek Drainage	Alluvium	Future	C	C	C	C
GW-CC2	Well Downgradient of Mine Pit in Clancy Creek Drainage	Alluvium	Future	C	C	C	C
GW-New-Recovery	Monitoring/Recovery Well(s) Downgradient of Tailings Storage Facility and South Pond	Alluvium-Bedrock	Future	C	C	C	C

Notes:
a Indicates the monitoring well was destroyed during mining, would be destroyed by proposed M-Pit Mine expansion, or is not included in the current operational monitoring program.
C = Complete analysis (Parameters listed in **Table 3.6-3**)
C_{ex} = Extended complete analysis (Complete analysis plus cyanides and ammonia as nitrogen)
WL = Water level measurement only

TABLE 3.6-2 MONITORING WELL COMPLETION DATA					
Well No.	**Lithology**	**Well Depth (feet bgs)**	**Screened Interval (feet bgs)**	**Hydraulic Properties**	**Remarks**
GW-1	Bedrock	260	200 - 250	T = 30 gpd/ft K = 0.07 ft/day	SWL = 42 ft; Drilled to 600 ft
GW-2	Bedrock	---	---	T = 430 gpd/ft K = 1.0 ft/day	---
GW-3	Bedrock	300	200 – 300	---	SWL = 134 ft; Yields 3-5 gpm
GW-4	Alluvium	---	---	---	---
GW-5	Alluvium-Bedrock	93	79 – 93	---	SWL = 75 ft; Yields 3-7 gpm
GW-6	Alluvium	---	---	---	---
GW-7	Alluvium	36	19 - 34	K = 10 ft/day	SWL = 12 ft; Yields 10-15 gpm
GW-8	Alluvium	148	123 - 148	---	SWL = 124 ft; Yields 15 gpm
GW-9	Alluvium	139	114 - 139	---	SWL = 117 ft; Yields 15 gpm
GW-10	Alluvium-Bedrock	35	1 - 35	---	SWL = 4 ft; Yields <1 gpm
GW-21	Alluvium-Bedrock	99	39 - 99	---	SWL = 60 ft; Yields 1-2 gpm
GW-22	Alluvium-Bedrock	99	75 - 95	---	SWL = 85 ft
GW-27	Alluvium-Bedrock	103	82 - 102	---	SWL = 90 ft; Yields 2 gpm
GW-28	Alluvium-Bedrock	90	37 – 57; open hole to 90 ft	---	SWL = 83 ft; Yields <1 gpm
GW-29	Alluvium-Bedrock	95	52 – 72; open hole to 95 ft	---	SWL = 84 ft; Yields <1 gpm
GW-34	Alluvium-Bedrock	119	79 - 119	---	SWL = 89 ft; Yields 30 gpm
GW-40	Mostly Bedrock	200 – 400	---	---	Yields <1 gpm
GW-41	Mostly Bedrock	200 – 400	---	---	Yields <1 gpm
GW-42	Mostly Bedrock	200 – 400	---	---	Yields <1 gpm
MW-1	Alluvium-Bedrock	85	65 – 85	---	---
MW-2	Alluvium-Bedrock	85	45 – 85	---	---

TABLE 3.6-2 MONITORING WELL COMPLETION DATA					
Well No.	**Lithology**	**Well Depth (feet bgs)**	**Screened Interval (feet bgs)**	**Hydraulic Properties**	**Remarks**
MW-3	Alluvium-Bedrock	57	17 – 57	---	---
MW-4	Alluvium-Bedrock	64	24 – 44	---	---
PW-1	Bedrock	149	---	---	Yields 30 gpm

Notes:
bgs = Below ground surface
ft/day = Feet per day
gpd/ft = Gallons per day per foot
gpm = Gallons per minute.
K = Hydraulic conductivity
SWL = Static water level
T = Transmissivity
--- = No data available
Sources: DSL 1985; Montana Tunnels 2007.

Hydraulic Properties

Pumping tests were performed to evaluate hydraulic properties for several monitoring wells in the study area (Montana Tunnels 2007). Data provided in **Table 3.6-2** indicate that the permeability for alluvial material in valley bottoms is generally higher than the permeability in bedrock by at least one order of magnitude. For example, pumping tests for wells completed in Spring Creek alluvium indicate values for hydraulic conductivity up to 330 feet per day (ft/day) (Montana Tunnels 2007).

Hydraulic conductivity for Clancy Creek alluvium at monitoring well GW-7 was estimated to be approximately 10 ft/day. The hydraulic conductivity for bedrock in the vicinity of monitoring well GW-1 near the northwest pit highwall was estimated to be 0.07 ft/day (DSL 1985). Hydraulic conductivities from pumping tests conducted in diatreme rock in the center of the mine pit area prior to excavation of the pit ranged from 0.3 to 30 ft/day (DSL 1985).

Mine Dewatering

Groundwater inflows represent a large portion of water that enters the mine pit during active mining. During the past 20 years, extensive dewatering, using in-pit sumps, horizontal pit highwall drains, and external wells, has taken place and would continue during active mining. During operations, mine water is collected and used to augment other sources of makeup water for the mill.

Up to several hundred gallons per minute (gpm) are produced by dewatering wells peripheral to the pit and from inflows to the pit; the average monthly rate of mine pit dewatering has varied over the past 20 years of mining from about 25 gpm to 900 gpm. The variability in mine pit inflow is primarily due to variability in bedrock fracture and fault conditions and seasonal variability in precipitation and groundwater recharge. Larger inflows would be expected when saturated bedrock fractures, joints or faults are first encountered, and after spring precipitation recharges the local bedrock aquifer. From November 2005 to October 2006, the average annual rate of mine dewatering was 332 gpm (0.74 cfs); the average monthly inflow to the mine pit ranged from 76 gpm (0.17 cfs) in February 2006 to 729 gpm (1.6 cfs) in July 2006 (Montana Tunnels 2007).

Groundwater Quality

Groundwater quality samples have been analyzed according to the parameter list provided in **Table 3.6-3**. In 1998, DEQ eliminated boron, chromium, mercury, molybdenum, selenium, and silver from the parameter list because previous groundwater quality data indicated that these constituents were below or near laboratory detection limits.

Groundwater quality data for selected parameters and monitoring wells in the study area are presented in **Table 3.6-4**. The table includes data for baseline conditions in 1984 prior to mining by Montana Tunnels (where available) and more recent operational conditions from 1999 through 2006. **Table 3.6-4** is a compilation of groundwater quality data provided to DEQ by Montana Tunnels in annual reports for Operating Permit 00113 (Montana Tunnels 2007). Annual reports provide groundwater quality data for selected constituents in a format that evaluates average water quality for 5-year time periods. To maintain consistency with the DEQ-required format provided in annual reports, and for the purpose of comparison, **Table 3.6-4** provides water quality data for all constituents presented in the annual reports for two recent 5-year periods: 1999 to 2003 and 2002 to 2006.

Monitoring wells that existed during the baseline period of measurement are GW-3, GW-5 and GW-7 **(Table 3.6-4)**. All other monitoring wells included in **Table 3.6-4** were installed subsequent to the baseline monitoring period. Results of groundwater quality monitoring data provided in **Table 3.6-4** are summarized below for the mine pit, the tailings storage facility, the waste rock storage, and the mine facilities areas.

TABLE 3.6-3 ANALYTICAL PARAMETER LIST		
Parameter	**Reporting Limit and Units**	**DEQ-7 Groundwater Standard or SMCL**
Static Water Level	0.1 foot	---
Water Temperature	°C	---
Specific Conductance	1.0 µmhos/cm	---
pH	Standard units	6.5 – 8.5[a]
Alkalinity as $CaCO_3$	5 milligrams per liter (mg/L)	---
Bicarbonate	5 mg/L	---
Carbonate	5 mg/L	---
Acidity as $CaCO_3$	5 mg/L	---
Total Dissolved Solids	10 mg/L	500[a]
Total Suspended Solids	10 mg/L	---
Total Hardness as $CaCO_3$	1.0 mg/L	---
Calcium	1.0 mg/L	---
Magnesium	0.1 mg/L	---
Sodium	0.1 mg/L	---
Potassium	0.1 mg/L	---
Chloride	1.0 mg/L	250[a]
Nitrate plus Nitrite as Nitrogen	0.01 mg/L	10
Sulfate	1.0 mg/L	250[a]
Phosphorus, total	0.001 mg/L	---
Arsenic	0.003 mg/L	0.01
Cadmium	0.0001 mg/L	0.005
Copper	0.001 mg/L	1.3
Iron	0.01 mg/L	0.3[a]
Lead	0.003 mg/L	0.015
Manganese	0.005 mg/L	0.05[a]
Zinc	0.01 mg/L	2.0
Cyanide, total	0.005 mg/L	0.2
Cyanide, weak acid dissociable	0.005 mg/L	---
Ammonia as N	0.05 mg/L	2.0
Aluminum	0.1 mg/L	---
Antimony	0.003 mg/L	0.006
Beryllium	0.001 mg/L	0.004
Boron	0.1 mg/L	---
Chromium	0.001 mg/L	0.10
Mercury	0.0006 mg/L	0.002
Molybdenum	0.005 mg/L	---
Nickel	0.02 mg/L	0.10
Selenium	0.001 mg/L	0.05
Silver	0.003 mg/L	0.10
Thallium	0.003 mg/L	0.002

TABLE 3.6-3 (Cont.)
ANALYTICAL PARAMETER LIST

Notes:
µmhos/cm = Micro mhos per centimeter
a = Federal secondary maximum contaminant level for public water systems (40 CFR Part 143)
cfs = Cubic feet per second
mg/L = Milligrams per liter
SMCL = Secondary maximum contaminant level
--- = No DEQ-7 groundwater standard or SMCL is available.
Source: Montana Tunnels 2007.

TABLE 3.6-4 SUMMARY OF GROUNDWATER QUALITY DATA							
Sample Date	**pH**	**Sulfate**	**Nitrate + Nitrite**	**Cadmium**	**Copper**	**Manganese**	**Zinc**
MONITORING WELL GW-3 – Downgradient Of Waste Rock Storage Area							
1984 Baseline	7.9	28	---	0.003	<0.01	<0.02	0.02
1999-2003 average	7.9	51	0.33	NC	NC	NC	NC
2002-2006 average	7.9	49	0.35	NC	NC	NC	NC
MONITORING WELL GW-4 – Beneath Existing Tailings Dam							
1984 Baseline	**3.2**	622	---	0.034	<0.01	20.7	6.56
1999-2003 average	---	---	---	---	---	---	---
2002-2006 average	---	---	---	---	---	---	---
MONITORING WELL GW-5 – Downgradient Of Tailings And South Pond							
1984 Baseline	6.6	281	---	0.007	<0.01	0.54	0.41
1999-2003 average	6.9	439	0.42	0.0004	NC	0.57	0.19
2002-2006 average	6.9	478	0.10	0.0003	0.001	0.74	0.17
MONITORING WELL GW-7 – Clancy Creek Alluvium							
1984 Baseline	6.4	52	---	0.005	<0.01	0.07	0.06
2003-2004 average[a]	7.6	50	0.06	<0.0001	<0.001	0.469	0.03
2002-2006 average	---	---	---	---	---	---	---
MONITORING WELL GW-8 - Downgradient Of Tailings And South Pond							
1986 Operational	6.8	246	1.04	<0.001	<0.01	---	1.7
1999-2003 average	7.1	405	0.58	0.0011	0.002	NC	0.17
2002-2006 average	7.1	508	0.72	0.0011	0.003	NC	0.19
MONITORING WELL GW-9 – Downgradient Of Tailings							
1999-2003 average	7.4	100	0.42	0.0002	NC	NC	0.01
2002-2006 average	7.4	124	0.44	0.0001	NC	NC	NC
MONITORING WELL GW-10 - Downgradient Of Tailings And South Pond							
1999-2003 average	6.6	540	1.80	0.0173	0.004	1.19	5.91
2002-2006 average	6.8	635	1.55	0.0120	0.003	1.39	5.03
MONITORING WELL GW-21 - Downgradient Of Tailings And South Pond							
1999-2003 average	7.4	329	0.22	NC	NC	0.44	0.016
2002-2006 average	7.3	418	0.65	0.0002	NC	0.54	0.014
MONITORING WELL GW-22 - Downgradient Of Tailings And South Pond							
1999-2003 average	7.5	267	0.39	0.0009	NC	NC	0.028
2002-2006 average	7.4	414	0.43	0.0012	0.001	NC	0.030
MONITORING WELL GW-27 - Downgradient Of Tailings And South Pond							
1999-2003 average	7.1	473	0.78	0.0004	0.001	NC	0.15
2002-2006 average	7.1	549	1.35	0.0007	0.002	0.022	0.21
MONITORING WELL GW-28 - Downgradient Of Tailings							
1999-2003 average	7.6	101	0.04	NC	NC	0.38	NC
2002-2006 average	7.5	134	0.23	NC	NC	0.38	NC
MONITORING WELL GW-29 - Downgradient Of Tailings And South Pond							
1999-2003 average	7.1	723	NC	NC	NC	1.77	0.01
2002-2006 average	7.1	778	NC	NC	0.002	1.99	NC

TABLE 3.6-4
SUMMARY OF GROUNDWATER QUALITY DATA

Sample Date	pH	Sulfate	Nitrate + Nitrite	Cadmium	Copper	Manganese	Zinc
MONITORING WELL GW-34 - Downgradient Of Tailings And South Pond							
1999-2003 average	7.0	550	NC	0.0016	0.002	1.45	0.82
2002-2006 average	7.1	586	NC	0.0012	0.002	2.24	0.65
MONITORING WELL MW-1 – Downgradient Of Tailings and Waste Rock Storage Area							
1999-2003 average	7.0	347	0.40	0.0005	NC	NC	NC
2002-2006 average	7.0	473	0.40	0.0001	NC	NC	NC
MONITORING WELL MW-2 – Downgradient Of Tailings and Waste Rock Storage Area							
1999-2003 average	6.9	466	0.31	0.0042	NC	NC	1.21
2002-2006 average	6.8	623	0.3	0.0078	0.003	NC	2.63
MONITORING WELL MW-4 – Downgradient Of Waste Rock Storage Area							
1999-2003 average	7.6	122	0.03	0.0003	0.002	1.72	0.01
2002-2006 average	7.5	119	NC	NC	0.002	1.35	NC
MONITORING WELL PW-1 – East Of Plant Site							
1999-2003 average	7.6	70	0.02	NC	NC	0.027	0.04
2002-2006 average	7.6	106	NC	NC	0.001	0.235	0.02
PIT SUMP– Bottom of Mine Pit							
1999-2003 average	7.9	247	0.32	0.0007	0.001	2.01	0.42
2002-2006 average	7.6	308	1.2	0.0006	0.001	0.54	0.28
DEQ-7 Groundwater Standard or SMCL	6.5-8.5[b]	250[b]	10	0.005	1.3	0.05[b]	2.0

Notes:
See **Figure 3.6-1** for monitoring well locations.
All units are in milligrams per liter, except pH which is in standard pH units.
All metals concentrations are for dissolved constituents in groundwater.
a = Data for monitoring well GW-7 were not available for 1999 to 2003, or 2002 to 2006; instead, 2003 to 2004 data from wells SH97-3, SH97-4, SH97-5, SH97-6, SH97-7, and SH97-14 that were also completed in Clancy Creek alluvium are used for this statistical analysis.
b = Value listed is an SMCL.
Baseline = One sample was collected from each well between September and October 1984.
mg/L = Milligrams per liter.
NC = The average concentration was not calculated because more than 50 percent of the concentrations were below laboratory detection limit values.
Shaded cell = Concentration exceeds DEQ-7 groundwater standard or SMCL.
SMCL = Secondary maximum contaminant level
--- =No data available
Source: DSL 1985; Montana Tunnels 2007

Mine Pit Area
The pit sump is located in the mine pit and conveys water collected from the bottom of the open pit mine (**Figure 3.6-1)**. The concentrations of metals in the mine pit provided in Table 3.6-4 were below DEQ-7 groundwater standards. Water collected in the pump sump is recirculated in the milling process, and is not discharged off-site.

The average concentration of sulfate in the mine pit sump exceeded the SMCL (2002-2006 average), and exhibited an increasing trend in concentration over time (**Table 3.6-4**). The average concentrations of manganese (1999-2003 and 2002-2006 averages) also exceeded the SMCL (**Table 3.6-4)**.

Tailings Storage Facility Area
Groundwater quality downgradient of the south pond has historically been impacted by infiltration of relatively poor quality water discharging from historic mines in the upper reaches of Pen Yan Creek and Wood Chute Gulch drainages to the west (*e.g.*, the Washington, Minah, and Blue Bird mines) and the Alta Mountain area to the northeast. Groundwater in the Homestake Gulch and Pen Yan Creek drainages was acidic and exhibited elevated concentrations of cadmium, iron, lead, manganese, and zinc that exceeded DEQ-7 groundwater standards or SMCL before current mining activities at Montana Tunnels began (DSL 1985). Recently completed reclamation of historic mines in the Spring Creek drainage will likely improve groundwater quality in this area.

Monitoring wells GW-5, GW-8, GW-9, GW-10, GW-21, GW-22, GW-27, GW-28, GW-29, and GW-34 are located downgradient of the Montana Tunnels tailings storage facility and south pond (**Figure 3.6-1**). The average concentrations of metals in these monitoring wells were generally below DEQ-7 groundwater standards, except for cadmium at monitoring well GW-5 (during the 1984 baseline period), and cadmium and zinc at monitoring well GW-10 (from 1999 through 2006) (**Table 3.6-4)**.

The average concentrations of sulfate or manganese in monitoring wells GW-5, GW-8, GW-10, GW-21, GW-22, GW-27, GW-28, GW-29, and GW-34 have generally exceeded SMCL, and many wells exhibited an increasing trend in the concentrations of sulfate or manganese over time (**Table 3.6-4**).

Waste Rock Storage Area
Monitoring wells located downgradient of the waste rock storage area include GW-3, MW-1, MW-2, MW-3, and MW-4 (**Figure 3.6-1**).

Bedrock monitoring well GW-3 is screened from about 200 to 300 feet and has generally exhibited little change in groundwater quality over the period of record from 1984 to 2006. Monitoring well GW-3 exhibited low concentrations of metals with more than 50 percent of the data below the laboratory detection limit value. The average concentration of sulfate increased from 28 mg/L (1984 baseline concentration) to 49

mg/L (2002-2006 average concentration), but is considerably below the SMCL (250 mg/L).

Monitoring wells MW-1, MW-2 and MW-4 are screened in alluvium and bedrock. The average concentrations of metals were generally below DEQ-7 groundwater standards. The average concentrations of cadmium and zinc at monitoring well MW-2 (2002-2006 average) exceeded DEQ-7 groundwater standards.

The average concentrations of sulfate in monitoring wells MW-1 and MW-2 exceeded the SMCL (250 mg/L) and have exhibited an increasing trend in concentration over time (**Table 3.6-4**). The average concentration of manganese at monitoring well MW-4 exceeded the SMCL (1999-2003 and 2002-2006 averages) (**Table 3.6-4)**.

Former Water Supply Well
Former water supply well PW-1 is completed in bedrock near the plant site (**Figure 3.6-1)**. The average concentrations of metals were below DEQ-7 groundwater standards **(Table 3.6-4**). The average concentration of manganese (0.235 mg/L) exceeded the SMCL (2002 to 2006 average).

3.6.3 Environmental Consequences

3.6.3.1 Alternative 1 – No Action Alternative (L-Pit)

Groundwater Quantity

L-Pit Area
Up to several hundred gallons per minute (gpm) are produced by dewatering wells peripheral to the pit and from inflows to the pit; the average monthly rate of mine pit dewatering has varied over the past 20 years of mining from about 25 gpm to 900 gpm. The variability in mine pit inflow is primarily due to variability in bedrock fracture and fault conditions and seasonal variability in precipitation and groundwater recharge. Larger inflows would be expected when saturated bedrock fractures, joints or faults are first encountered, and after spring precipitation recharges the local bedrock aquifer.

Flow of groundwater into the mine pit and the loss of this potential groundwater recharge to the Spring Creek drainage during almost two centuries of pit filling would be an adverse long-term impact. Because the loss of recharge has not had a measurable impact on the flow in Spring Creek during the past 20 years of mining, it would not be expected to have a measurable impact in the future.

The post-mining L-Pit lake elevation, area, and volume were estimated by a water-balance model developed by Montana Tunnels and reviewed by the agencies. According to water-balance modeling, the mine pit for Alternative 1 would continue to

act as a groundwater sink for many years (Montana Tunnels 2007). The model estimates that groundwater and other sources of inflow would enter the pit, and the lake surface elevation would rise until the cumulative inflows and losses from the pit lake reach equilibrium at elevation 5,610 feet, approximately 60 feet below the lowest point along the rim of the L-Pit (5,670 feet) (Montana Tunnels 2007). The model estimates that the maximum pit lake elevation of 5,610 feet would occur almost two centuries after mining ceases (Montana Tunnels 2007). No surface water outflow from the pit lake would be anticipated for Alternative 1.

The Montana Tunnels water-balance model for Alternative 1 assumes groundwater inflows to the mine pit would range from about 574 gpm (1.3 cfs) at the time mining ceases to about 32 gpm (0.07 cfs) prior to the pit lake reaching equilibrium after almost two centuries of filling. After the pit lake reaches equilibrium, the model predicts that up to 7 gpm (0.0154 cfs) of pit seepage could discharge to groundwater in the Spring Creek drainage (Montana Tunnels 2007).

After the pit lake reaches equilibrium almost two centuries after mining ceases, the seepage of 7 gpm of water from the pit lake to groundwater in the Spring Creek drainage would be a long-term beneficial impact from the standpoint of water availability.

Clancy Creek Alluvium

Seepage of groundwater from Clancy Creek alluvium to the mine pit was addressed in the 1986 final EIS for Montana Tunnels, and was estimated to range between 10 gpm (0.02 cfs) and 90 gpm (0.20 cfs) (DSL 1985). The relatively low seepage rate is in part due to low permeability of bedrock and seepage would vary on a seasonal basis. The seepage of 10 gpm (0.02 cfs) to 90 gpm (0.2 cfs) of groundwater from Clancy Creek alluvium to the mine pit would be an adverse long-term impact.

Tailings Storage Facility Area

After cessation of mining, water that collects in the south pond would be pumped to the mine pit to help accelerate pit lake development during the 5-year closure period. Flows to the south pond during the 5-year closure period would include seasonal surface water runoff from the reclaimed tailings surface, seepage from the tailings storage facility, and discharge from the downgradient recovery well system. After the 5-year closure period, the south pond would be reclaimed and converted to a percolation pond by excavating the clay liner from the bottom of the pond to expose the underlying native colluvium (Montana Tunnels 2007). Operation of the recovery well system would be discontinued at the end of the 5-year closure period. Surface water runoff from the reclaimed tailings surface and seepage from the tailings storage facility would be diverted to the percolation pond and would then recharge the underlying groundwater system and subsequently flow towards Spring Creek.

The tailings storage facility would continue to seep as long as the tailings mass continued to consolidate. The amount of seepage would vary with time (Montana Tunnels 2007). Seepage flows associated with tailings consolidation would be about 181 gpm (0.40 cfs) the 5th year following cessation of mining and would decrease to 120 gpm (0.27 cfs) by the 10th year, 15 gpm (0.03 cfs) by the 25th year, and zero flow by the 50th year, when the tailings would likely be fully consolidated (Montana Tunnels 2007).

Seepage through the tailings cover would contribute to groundwater recharge and would be about 22 gpm (0.05 cfs) (Montana Tunnels 2007). By way of example, the total recharge to groundwater from the tailings storage facility at year 10 after mining would approach about 142 gpm (0.32 cfs) (120 gpm [0.27 cfs] from tailings consolidation, plus 22 gpm [0.05 cfs] through the cover). The seepage rate for year 10 after mining was selected for the purpose of illustration in this analysis; in fact, the estimated seepage rate would be greater from year 5 through year 9 after mining and would be smaller from year 11 through year 50 after mining and beyond.

At the end of the 5-year closure period, seepage from the tailings storage facility would become part of the groundwater regime of the Spring Creek drainage. In addition, seasonal runoff from the reclaimed tailings surface would also be routed to the reclaimed south pond and underlying groundwater. The runoff volume from the reclaimed tailings surface would be seasonal (about 200 gpm [0.45 cfs]) and would also vary from year to year depending on many factors including annual precipitation, evapotranspiration, and snowpack.

The recharge to groundwater from the reclaimed south pond infiltration structure would be a long-term and beneficial impact from the standpoint of groundwater availability in the Spring Creek drainage.

Waste Rock Storage Area

Precipitation that infiltrates through the waste rock storage area would most likely result in seepage to underlying groundwater. Hydrologic modeling was conducted by Montana Tunnels to predict the rate of infiltration through the reclaimed waste rock storage area. Results of this modeling indicated the estimated seepage rate would be approximately 40 gpm (0.09 cfs). Seepage through the waste rock storage area would infiltrate to groundwater and become part of the groundwater regime of the Spring Creek drainage. No toe seeps associated with the waste rock storage area have been observed during active mining and would not be anticipated in the future. If toe seeps developed, seepage would quickly infiltrate to the colluvium and alluvium of the Pen Yan and Wood Chute Flats drainages.

Groundwater Quality

Mine Pit

The Montana Tunnels Mine was permitted to be reclaimed as a pit lake in 1986. The 1986 final EIS stated that it would be difficult to accurately predict the water quality in the mine pit at the time the pit lake reached equilibrium (DSL 1985). The 1986 final EIS speculated that the post-mining mine pit lake would likely contain a calcium-magnesium-sulfate type water with a pH below 7.0. Pit water was expected to contain concentrations of iron, manganese, and zinc between 0.5 mg/L and several milligrams per liter. Concentrations of aluminum, cadmium, copper, and lead were expected to range from a few hundredths to a few tenths of a milligram per liter (DSL 1985).

Bedrock groundwater quality in the vicinity of the mine pit and predicted water quality for the L-Pit lake, once it reaches equilibrium almost two centuries after mining ceases, are presented in **Table 3.6-5** (Montana Tunnels 2007). **Table 3.6-5** shows that, except for the concentration of iron, the concentrations of constituents in the pit lake at equilibrium would be higher than the existing concentrations of the same constituents in surrounding bedrock. The Montana Tunnels model-predicted pit lake water quality would meet all DEQ-7 groundwater standards, but iron and manganese would exceed SMCL. The concentrations of iron and manganese in bedrock groundwater in the vicinity of the mine pit also currently exceed SMCL. The quality of water in the pit lake and the adjacent bedrock aquifer would be comparable, and no measurable impact to groundwater would be anticipated.

A mixing model was constructed by the agencies to quantitatively evaluate the impact of 7 gpm (0.02 cfs) of seepage from the L-Pit lake, beginning about two centuries after mining, on groundwater quality in the Spring Creek drainage near monitoring well GW-5 (**Figure 3.6-1**). The mixing model estimated the concentration of constituents in groundwater at monitoring well GW-5, as well as the percent change in concentrations of constituents compared to baseline groundwater concentrations. The results of this analysis are presented in **Table 3.6-6**.

Modeling results presented in **Table 3.6-6** suggest that almost two centuries after mining, there would be a decrease in the concentration of most constituents.

TABLE 3.6-5
NO ACTION ALTERNATIVE (L-PIT)
COMPARISON OF L-PIT LAKE WATER QUALITY
AND BEDROCK GROUNDWATER QUALITY

Parameter	Predicted [a] L-Pit Lake Water Quality at Lake Elevation 5,610 feet	Existing Bedrock Groundwater Quality In Vicinity of Mine Pit	DEQ-7 Groundwater Standard or SMCL
pH	7.5 – 8.5	7.8	6.5 – 8.5*
Calcium	99.14	80.5	--
Magnesium	26.61	25.3	--
Sodium	20.85	16.8	--
Potassium	14.54	6.5	--
Sulfate	197.52	140.7	250*
Chloride	4.22	2.4	250*
Fluoride	0.51	0.2	4.0
Nitrate+Nitrite	0.65	0.008	10
Cyanide - Total	NC	<0.01	0.2
Arsenic	0.007	0.006	0.01
Cadmium	0.0008	0.00005	0.005
Copper	0.0088	0.002	1.3
Iron	0.36	0.4	0.3*
Lead	0.0036	0.002	0.015
Manganese	0.60	0.1	0.05*
Silver	0.0023	0.002	0.1
Zinc	0.0405	0.005	2.0

Notes:

All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
Shaded cell = indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less than
-- = No DEQ-7 groundwater standard or SMCL is available for this constituent
a = Source: Montana Tunnels 2007.

TABLE 3.6-6
NO ACTION ALTERNATIVE (L-PIT)
IMPACTS RELATED TO 7 GPM OF L-PIT LAKE SEEPAGE TO GROUNDWATER

Parameter	Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984	Expected Quality of Seepage from L-Pit Lake	Predicted Impact - Concentration in Groundwater near Monitoring Well GW-5	Predicted Impact- Percent Change in Concentration over Baseline Conditions	Montana Groundwater Standard or SMCL
pH	6.6	7.5 – 8.5	NC	NC	6.5 – 8.5*
Calcium	96	99.14	96.23	0%	--
Magnesium	21	26.61	21.41	2%	--
Sodium	20	20.85	20.06	0%	--
Potassium	ND	14.54	ND	ND	--
Sulfate	281	197.52	275	-2%	250*
Chloride	6	4.22	5.87	-2%	250*
Fluoride	0.18	0.51	0.18	13%	4.0
Nitrate+Nitrite	0.85	0.65	0.84	-2%	10
Cyanide, total	<0.01	<0.01	<0.01	NCB	0.2
Arsenic	<0.005	0.007	<0.0028	NCB[1]	0.01
Cadmium	0.007	0.0008	0.0065	-6%	0.005
Copper	<0.01	0.0088	<0.0053	NCB	1.3
Iron	0.55	0.36	0.54	-3%	0.3*
Lead	0.03	0.0036	0.028	-6%	0.015
Manganese	0.54	0.60	0.544	1%	0.05*
Silver	<0.005	0.0023	<0.0025	NCB	0.1
Zinc	0.41	0.0405	0.38	-7%	2.0

Notes:

1 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL is available for this constituent.

TABLE 3.6-7 NO ACTION ALTERNATIVE (L-PIT) IMPACTS RELATED TO 142 GPM OF SEEPAGE FROM TAILINGS STORAGE FACILITY TO GROUNDWATER					
Parameter	**Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984**	**Tailings Storage Facility Combined Drains Water Quality 2002-2005**	**Predicted Impact -Concentration in Groundwater Well GW-5 [a]**	**Predicted Impact-Percent Change in Concentration over Baseline Conditions**	**DEQ-7 Groundwater Standard or SMCL**
pH	6.6	7.09	NC	NC	6.5 – 8.5*
Calcium	96	192.8	155.5	62%	--
Magnesium	21	43.1	34.6	65%	--
Sodium	20	32.6	27.2	39%	--
Potassium	ND	36.2	ND	NC	--
Sulfate	281	623	491	75%	250*
Chloride	6	12.9	10.2	71%	250*
Fluoride	0.18	0.6	0.44	143%	4.0
Nitrate+Nitrite	0.85	0.26	0.49	-43%	10
Cyanide, total	<0.01	0.031	<0.021	NCB	0.2
Arsenic	<0.005	0.005	<0.0040	NCB[1]	0.01
Cadmium	0.007	0.0004	0.0029	-58%	0.005
Copper	<0.01	0.005	<0.0050	NCB	1.3
Iron	0.55	1.72	1.27	131%	0.3*
Lead	0.03	<0.003	0.013	-58%	0.015
Manganese	0.54	4.495	2.97	450%	0.05*
Silver	<0.005	<0.0005	<0.005	NCB	0.1
Zinc	0.41	0.17	0.26	-36%	2.0

Notes:
1 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards in groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
a = Based on 142 gpm seepage at year 10 after mining.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL is available for this constituent

The predicted concentration of cadmium in the L-Pit lake (0.0008 mg/L) would be below the DEQ-7 groundwater standard (0.005 mg/L). However, the model-predicted concentration of cadmium in groundwater (0.0065 mg/L; a 6 percent decrease) exceeded the DEQ-7 groundwater standard only because the baseline concentration of cadmium (0.007 mg/L) also exceeded the DEQ-7 groundwater standard.

Based on this analysis, L-Pit lake seepage equal to 7 gpm would not adversely impact groundwater quality in the Spring Creek drainage.

Tailings Storage Facility Area

For Alternative 1, the south pond liner would be breached to form an infiltration structure at the end of the 5-year closure period. Seepage from this structure would mix with underlying groundwater and would then flow southeastward toward Spring Creek. Seepage water quality would likely be similar in quality to water from the tailings storage facility combined drains (Montana Tunnels 2007), as shown on **Table 3.6-7**. Seepage water from the combined drains is hard (elevated calcium and magnesium) with concentrations of sulfate, iron, and manganese that exceed SMCL. The combined drain water also exhibits low levels of total cyanide (0.015 to 0.042 mg/L), which is below the DEQ-7 groundwater standard (0.2 mg/L).

A mixing model was constructed by the agencies to quantitatively evaluate the impact of 142 gpm (0.32 cfs) of tailings storage facility seepage (year 10 after mining) on groundwater in the Spring Creek drainage near monitoring well GW-5. The seepage rate for year 10 after mining was selected for the purpose of illustration in this analysis; in fact, the estimated seepage rate would be greater from year 5 through year 9 after mining and would be smaller from year 11 through year 50 after mining (and beyond). The results of this analysis are presented in **Table 3.6-7**.

The mixing model indicates that at year 10 after mining, there would be an increase in the concentration of several constituents in groundwater including sulfate (75 percent increase), iron (131 percent increase), and manganese (450 percent increase). The resulting concentrations would exceed SMCL. Premining concentrations of these constituents exceeded SMCL in 1984 (**Table 3.6-7)**. In addition, the mixing model indicates that at year 10 after mining, there would be an increase in the concentration of cyanide in groundwater at monitoring well location GW-5; the resulting concentration of cyanide (<0.021 mg/L) would still be about an order of magnitude lower than the DEQ-7 groundwater standard (0.2 mg/L). The mixing model, however, does not take into account the trend of decreasing cyanide concentration in discharge from the tailings impoundment's under-drains over the past 16 years. Recent (2002 – 2005) water quality data from GW-5 indicate that concentrations of cadmium, lead, and zinc have declined since the baseline data collection period while concentrations of iron and sulfate have increased. Arsenic remains below the detection limit, likely due to co-precipitation of arsenic with iron when the tailings seepage mixes with groundwater.

Manganese concentrations at GW-5 have varied but on average have remained near baseline conditions. Deviations of actual groundwater quality from the mixing model's predictions indicate that additional geochemical processes such as oxidation and precipitation attenuate some contaminants found in tailing seepage when it mixes with groundwater.

Seepage from the tailings storage facility after mining ceases and the resulting increase in the concentration of sulfate, iron, and manganese in groundwater would be an adverse long-term impact.

Waste Rock Storage Area

Seepage from the waste rock storage area would exit the base of this area and infiltrate into underlying groundwater. The quality of waste rock storage area seepage was estimated by Montana Tunnels based on results of testing waste rock material (Montana Tunnels 2007). Based on this testing, it is anticipated that waste rock storage area seepage would be similar to natural groundwater around the mine pit (Montana Tunnels 2007).

The rate of seepage from the 425.9-acre waste rock storage area was estimated by the agencies to be about 40 gpm (0.09 cfs) based on modeling conducted by Montana Tunnels using the Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder 1984) (Montana Tunnels 2007). HELP model results are most useful for comparing seepage rates among a variety of alternatives; the model-predicted seepage rates for the waste rock storage area are estimates, and results should be evaluated qualitatively. Waste rock storage area seepage would mix with underlying groundwater, and then flow southeastward toward Spring Creek.

A mixing model was constructed by the agencies to evaluate the impact of 40 gpm (0.09 cfs) of seepage from the waste rock storage area on the quality of groundwater in the Spring Creek drainage. To evaluate the sensitivity of the estimated rate of seepage, a higher seepage rate equal to 80 gpm (0.18 cfs) was also modeled. The mixing model was used to calculate the resulting groundwater concentration and the percent increase or decrease in concentrations over baseline concentrations. The results of the 40 gpm analysis are presented in **Table 3.6-8**, and the results for both models are discussed below.

The mixing model predicted a decrease in the concentration of most constituents relative to baseline concentrations. The mixing model indicated that no groundwater constituents would exceed DEQ-7 groundwater standards, except for lead (0.02 mg/L) which decreased in concentration from the 1984 baseline conditions (29 percent decrease). A groundwater mixing zone would likely be established by the DEQ that would set allowable loading rates based on size and location of the mixing zone, available groundwater flux, contaminant loads, and mixing zone requirements.

TABLE 3.6-8 NO ACTION ALTERNATIVE (L-PIT) IMPACTS RELATED TO 40 GPM OF SEEPAGE FROM WASTE ROCK STORAGE AREA TO GROUNDWATER					
Parameter	**Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984**	**Expected Quality of Seepage from Waste Rock Storage Area**	**Predicted Impact - Concentration in Groundwater near monitoring Well GW-5**	**Predicted Impact- Percent Change in Concentration over Baseline Conditions**	**DEQ-7 Groundwater Standard or SMCL**
pH	6.6	7.8	NC	NC	6.5 – 8.5*
Calcium	96	80.5	91.3488	-5%	--
Magnesium	21	25.3	22.2403	6%	--
Sodium	20	16.8	19.0698	-5%	--
Potassium	ND	6.5	NC	NC	--
Sulfate	281	140.7	237.5891	-15%	250*
Chloride	6	2.4	4.8837	-19%	250*
Fluoride	0.18	0.2	0.1862	3%	4.0
Nitrate+Nitrite	0.85	0.008	0.5889	-31%	10
Cyanide, total	<0.01	<0.01	<0.01	NCB	0.2
Arsenic	<0.005	0.006	<0.0036	NCB[1]	0.01
Cadmium	0.007	0.00005	0.0048	-31%	0.005
Copper	<0.01	0.002	<0.0041	NCB	1.3
Iron	0.55	0.4	0.5035	-8%	0.3*
Lead	0.03	0.002	0.0213	-29%	0.015
Manganese	0.54	0.1	0.4036	-25%	0.05*
Silver	<0.005	0.002	<0.0023	NCB	0.1
Zinc	0.41	0.005	0.2844	-31%	2.0

Notes:

1 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL for this constituent is available

Premining baseline (1984) concentrations of iron and manganese exceeded SMCL, as did the model-predicted concentrations of these constituents

Based on the above analysis, seepage from the waste rock storage area would not adversely impact groundwater quality in the Spring Creek drainage.

3.6.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Groundwater impacts for Alternative 2, the M-Pit Mine Expansion Plan, would be similar to the impacts for Alternative 1, except for those impacts described below.

Groundwater Quantity - Alternative 2

M-Pit Area

For Alternative 2, the M-Pit Mine Expansion would remove approximately 1,800 linear feet of alluvium and aquifer associated with Clancy Creek on the north side of the mine pit (**Figure 2.3-2**). Cutoff walls would be constructed to bedrock in the Clancy Creek valley bottom upstream of the mine pit area and in an ephemeral channel northwest of the pit. Cutoff walls would intercept groundwater flowing in the alluvium and divert the water into an open-flow channel and pipe constructed around the northwest side of the mine pit (**Figure 3.6-1**). Groundwater flows from these drainages would total about 5 gpm (0.01 cfs) to 10 gpm (0.02 cfs) (Montana Tunnels 2007). All water in the diversion channel would flow back into Clancy Creek downstream from the mine pit, where a portion would infiltrate back into alluvium and continue moving downgradient.

The excavation and removal of 1,800 linear feet of Clancy Creek alluvial aquifer would be an adverse and long-term impact.

For Alternative 2, groundwater levels in bedrock in the vicinity of the mine pit would likely continue to decline several hundred feet as the pit deepens from 4,250 to 4,050 feet. After mining ceases, the mine pit would continue to act as a groundwater sink for centuries (Montana Tunnels 2007). A water-balance model developed by Montana Tunnels estimates that groundwater and other sources of inflow would enter the pit, and the pit lake surface elevation would rise until the cumulative inflows and losses from the pit lake reach equilibrium at elevation 5,625 feet, about 25 feet below the elevation of Clancy Creek (5,650 ft) about two centuries after mining ceases. The equilibrium elevation for Alternative 2 (5,625 feet) is about 15 feet higher than for Alternative 1 (5,610 feet); this is due to higher inflows to the pit from Clancy Creek and tailings storage facility surface runoff for Alternative 2. No surface water outflow from the pit lake would be anticipated (Montana Tunnels 2007). The water-balance model indicates that groundwater inflows to the mine pit range from about 250 gpm (0.56 cfs) at the time mining ceases to about 21 gpm (0.05 cfs) prior to the pit lake reaching equilibrium at elevation 5,625 feet.

The flow of groundwater into the mine pit and the loss of this potential groundwater recharge to the Spring Creek drainage during about two centuries of pit filling would be an adverse long-term impact to groundwater availability in the Spring Creek drainage. At equilibrium conditions at lake elevation equal to 5,625 feet, groundwater inflow to the pit (equal to about 24 gpm) would continue indefinitely. Because the loss of recharge has not had a measurable impact on the flow in Spring Creek during the past 20 years of mining, it would not be expected to have a measurable impact to flow in Spring Creek in the future.

The post-mining M-Pit lake elevation, area, and volume were estimated by a water-balance model developed by Montana Tunnels and reviewed by the agencies. The water-balance model for Alternative 2 assumed that 67 gpm (0.15 cfs) of flow in Clancy Creek would augment the pit filling process and the formation of a pit lake after mining.

In summary, the M-Pit lake elevation, area, and volume would increase through time and would reach equilibrium at elevation 5,625 about two centuries after mining ceases. At that time, the model predicts that at least 360 gpm (0.08 cfs) of pit lake water would begin to seep to groundwater in the Spring Creek drainage through relatively permeable zones located along the southeast side of the mine pit (Montana Tunnels 2007). Seepage from the pit lake to groundwater in the Spring Creek drainage would be a long-term beneficial impact from the standpoint of water availability.

Tailings Storage Facility Area

The quantity of groundwater that has historically flowed southeast towards Spring Creek from the tailings storage facility would be reduced for Alternative 2 compared to Alternative 1 because surface water runoff from the natural catchment and reclaimed surfaces that previously reported to the Homestake Gulch catchment would be diverted toward the mine pit to facilitate formation of a pit lake for centuries. Once the pit lake reaches equilibrium (centuries after mining ceases) some of the pit inflow which would be runoff from the tailings storage facility area would once again report to the groundwater system in Spring Creek. Some of the surface water runoff (average annual runoff about 200 gpm (0.43 cfs)) historically infiltrated to groundwater (Montana Tunnels 2007).

Diverting 200 gpm of runoff from the reclaimed tailings surface into the mine pit (Alternative 2) instead of using the runoff to recharge the Spring Creek groundwater system (Alternative 1) would be an adverse long-term impact to groundwater availability in the Spring Creek drainage. Because the loss of recharge has not had a measurable impact on the flow in Spring Creek during the past 20 years of mining, it would not be expected to have a measurable impact on the flow of Spring Creek during the centuries it takes the mine pit to fill with water.

For Alternative 2, the tailings storage facility would increase in area (5.1 percent) and volume (27 percent) relative to Alternative 1. For the agencies' analysis, it was assumed that the total increase in seepage through the tailings storage facility cover and the combined drains would increase proportionally for Alternative 2. Seepage through the tailings storage facility cover was estimated by the agencies to be 25 gpm (0.06 cfs). Tailings storage facility consolidation seepage at year 10 after mining was estimated to be 170 gpm (0.38 cfs). The total tailings storage facility seepage at year 10 after mining was estimated by the agencies to be 195 gpm (0.43 cfs) for Alternative 2. The seepage rate for year 10 after mining was selected for the purpose of illustration in this analysis; in fact, the estimated seepage rate would be greater from year 5 through year 9 after mining and would be smaller from year 11 through year 50 after mining and beyond.

The anticipated seepage from the tailings storage facility (at year 10 after mining) to groundwater for Alternative 2 (195 gpm [0.43 cfs]) is 53 gpm (0.12 cfs) greater than seepage from the facility for Alternative 1 (142 gpm [0.32 cfs]). The recharge of 195 gpm (0.43 cfs) to groundwater in the Spring Creek drainage would be a long-term beneficial impact from the standpoint of groundwater availability.

Waste Rock Storage Area

The waste rock storage area would increase in area by 36 percent, from 425.9 acres (Alternative 1) to 579.1 acres (Alternative 2). For the agencies' analysis, it was assumed that seepage through the waste rock storage area for Alternative 2 would increase proportionally. Seepage through the waste rock storage area for Alternative 2 was estimated by the agencies to be 54 gpm (0.12 cfs), about 14 gpm (0.03 cfs) more than for Alternative 1 (40 gpm [0.09 cfs]). The recharge of 54 gpm (0.12 cfs) to groundwater in the Spring Creek drainage would be a long-term beneficial impact from the standpoint of groundwater availability.

Groundwater Quality - Alternative 2

M-Pit Area

The quality of the M-Pit lake after it reaches equilibrium at elevation 5,625 feet about two centuries after mining was estimated by a pit-filling and water quality model developed by Montana Tunnels and reviewed by the agencies. The pit filling model for Alternative 2 assumed that 67 gpm (0.15 cfs) of flow in Clancy Creek would augment the pit filling process and the formation of a pit lake after mining. This Clancy Creek water flow would be available for dilution in the pit lake as it fills after mining. Baseline groundwater quality in the Spring Creek drainage near monitoring well GW-5 and M-Pit lake water quality model results are presented in **Table 3.6-9**.

TABLE 3.6-9 PROPOSED ACTION (M-PIT) IMPACTS RELATED TO 360 GPM OF M-PIT SEEPAGE TO GROUNDWATER					
Parameter	**Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984**	**Model Predicted M-Pit Lake Water Quality at Elevation 5,625 feet**	**Model Predicted Impact - Concentration in Groundwater near Monitoring Well GW-5**	**Model Predicted Impact- Percent Change in Concentration over Baseline Conditions[1]**	**DEQ-7 Groundwater Standard or SMCL**
pH	6.6	7.5	NC	NC	6.5 – 8.5*
Calcium	96	50.67	59.66	(0%) -38%	--
Magnesium	21	18.6	19.08	(2%) -9%	--
Sodium	20	9.7	11.75	(0%) -41%	--
Potassium	ND	13.89	NC	(NC) NC	--
Sulfate	281	95.99	133	(-2%) -53%	250*
Chloride	6	3.28	3.82	(-2%) -36%	250*
Fluoride	0.18	0.21	0.20	(13%) 13%	4.0
Nitrate+Nitrite	0.85	0.27	0.38	(-2%) -55%	10
Cyanide, total	<0.01	0.00071	<0.0016	NCB	0.2
Arsenic	<0.005	0.004	<0.0037	NCB[2]	0.01
Cadmium	0.007	0.00015	0.0015	(-6%) -78%	0.005
Copper	<0.01	0.006	<0.0058	NCB	1.3
Iron	0.55	0.18	0.25	(-3%) -54%	0.3*
Lead	0.03	0.002	0.008	(-6%) -75%	0.015
Manganese	0.54	0.145	0.22	(1%)-59%	0.05*
Silver	<0.005	0.0016	<0.0018	NCB	0.1
Zinc	0.41	0.013	0.09	(-7%) -78%	2.0

Notes:

1 Values in parentheses are for Alternative 1 (see Table 3.6-6) and are provided for the purpose of comparing alternatives.
2 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL for this constituent is available

The 1984 baseline concentration of manganese in monitoring well GW-5 (0.54 mg/L) and the model-predicted concentration of manganese in the M-Pit lake once it reaches equilibrium (0.145 mg/L) exceed the SMCL (0.05 mg/L). The overall predicted M-Pit lake water quality would be better than was predicted for water quality of the L-Pit in the 1986 final EIS.

A mixing model was constructed by the agencies to evaluate the impact of 360 gpm (0.8 cfs) of seepage from the M-Pit lake on groundwater quality near monitoring well GW-5. The impact would not occur until about two centuries after mining ceases. The model calculated the new groundwater concentration and the percent increase or decrease in concentrations of constituents in groundwater at this location. Model results presented in **Table 3.6-9** indicate that all DEQ-7 groundwater standards would be met.

The mixing model indicates that the concentrations of sulfate, cadmium, iron, and lead would improve to below DEQ-7 groundwater standards or the SMCL. No adverse long-term seepage impacts from the pit lake on groundwater quality in the Spring Creek drainage would be anticipated for Alternative 2.

The mixing model indicates that the concentration of manganese (59 percent decrease) would exceed the SMCL. The premining baseline concentration of manganese also exceeded the SMCL in 1984.

Tailings Storage Facility Area

A mixing model was constructed by the agencies to evaluate the impact of 195 gpm (0.43 cfs) of seepage in year 10 after mining to groundwater. The model calculated the resulting groundwater concentration and the percent change in concentrations of constituents in groundwater over baseline groundwater concentrations. The seepage rate for year 10 after mining was selected for the purpose of illustration in this analysis, as explained above in the groundwater quantity section. The results of this analysis are presented in **Table 3.6-10**.

Table 3.6-10 indicates that for Alternative 2, all DEQ-7 groundwater standards would be met. There would be increases in the concentrations of some constituents including sulfate, cyanide, iron and manganese in groundwater. These increases in concentration are predicted in groundwater at the location of monitoring well MW-5. As previously noted for Alternative 1 above, the mixing model's predictions do not take into account geochemical attenuation processes which may lower the concentrations of some constituents when tailings seepage mixes with groundwater. Therefore, the model may over-predict the concentrations of some constituents. A groundwater mixing zone would likely be established by the DEQ that would set allowable loading rates based on size and location of the mixing zone, available groundwater flux, contaminant loads, and mixing zone requirements.

TABLE 3.6-10
PROPOSED ACTION (M-PIT) AND AGENCY MODIFIED ALTERNATIVE IMPACTS RELATED TO 195 GPM OF TAILINGS STORAGE FACILITY SEEPAGE TO GROUNDWATER

Parameter	Baseline Groundwater Quality from Well GW-5[a] October 1984	Tailings Storage Facility Combined Drains Average Values 2002-2005	Predicted Impact - Concentration in Groundwater at Year 10 After Mining Well GW-5	Predicted Impact-Percent Change in Concentration over Baseline Conditions[1]	DEQ-7 Groundwater Standard or SMCL
pH	6.6	7.09	NC	NC	6.5 – 8.5*
Calcium	96	192.8	162.4	(62%) 69%	--
Magnesium	21	43.1	36.2	(65%) 72%	--
Sodium	20	32.6	28.7	(39%) 43%	--
Potassium	ND	36.2	ND	(NC) NC	--
Sulfate	281	623	515.8	(75%) 84%	250*
Chloride	6	12.9	10.7	(71%) 79%	250*
Fluoride	0.18	0.6	0.47	(143%) 160%	4.0
Nitrate +Nitrite	0.85	0.26	0.44	(-43%) -48%	10
Cyanide, total	<0.01	0.031	<0.0229	NCB	0.2
Arsenic	<0.005	0.005	<0.0042	NCB[2]	0.01
Cadmium	0.007	0.0004	0.0025	(-58%) -65%	0.005
Copper	<0.01	0.005	<0.0050	NCB	1.3
Iron	0.55	1.72	1.35	(131%) 146%	0.3*
Lead	0.03	<0.003	0.0104	(-58%) -65%	0.015
Manganese	0.54	4.495	3.26	(450%) 503%	0.05*
Silver	<0.005	<0.0005	<0.005	NCB	0.1
Zinc	0.41	0.17	0.25	(-36%) -40%	2.0

Notes:

1 Values in parentheses are for Alternative 1 (see Table 3.6-7) and are provided for the purpose of comparing alternatives.
2 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL for this constituent is available

The predicted concentration of sulfate (84 percent increase), iron (146 percent increase), and manganese (503 percent increase) would exceed the SMCL. The baseline concentration of these constituents in groundwater in 1984 also exceeded the SMCL. Sulfate has laxative effects in humans and imparts an unpleasant taste to groundwater; infants are sometimes more sensitive than adults. Iron and manganese may cause stains on plumbing fixtures and laundry.

The mixing model indicates that the concentration of cyanide in groundwater would increase (<0.0229 mg/L), but would still be about an order of magnitude lower than the DEQ-7 groundwater standard (0.2 mg/L). The mixing model, however, does not take into account the trend of decreasing cyanide concentration in discharge from the tailings impoundment's under-drains over the past 16 years.

Waste Rock Storage Area

A mixing model was constructed by the agencies to evaluate the impact of 54 gpm (0.12 cfs) of seepage from the 579-acre waste rock storage area on the quality of groundwater in the Spring Creek drainage. To evaluate the sensitivity of the estimated rate of seepage, a higher seepage rate equal to 108 gpm (0.24 cfs) was also modeled. The mixing model was used to calculate the resulting groundwater concentration and the percent increase or decrease in concentrations over baseline concentrations. The results of the 54 gpm analysis are presented in **Table 3.6-11**, and the results for both models are discussed below.

The mixing model predicted a decrease in the concentration of most constituents relative to baseline concentrations. The mixing model indicated that no groundwater constituents would exceed DEQ-7 groundwater standards, except for lead (0.019 mg/L) which decreased in concentration over the 1984 baseline conditions (35 percent decrease for 54 gpm of seepage). These increases in concentration are predicted in groundwater at the location of monitoring well GW-5. A groundwater mixing zone would likely be established by the DEQ that would set allowable loading rates based on size and location of the mixing zone, available groundwater flux, contaminant loads, and mixing zone requirements.

The predicted concentrations of iron and manganese in groundwater due to seepage from the waste rock storage area would decrease compared to baseline conditions. Premining 1984 baseline concentrations of iron and manganese exceeded the SMCL, as did the model-predicted concentrations of these constituents.

Based on the above analysis, seepage from the waste rock storage area would not adversely impact groundwater quality in the Spring Creek drainage.

TABLE 3.6-11
PROPOSED ACTION (M-PIT) AND AGENCY MODIFIED ALTERNATIVE IMPACTS RELATED TO 54 GPM OF WASTE ROCK STORAGE AREA SEEPAGE TO GROUNDWATER

Parameter	Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984	Expected Quality of Seepage from Waste Rock Storage Area	Predicted Impact - Concentration in Groundwater near Monitoring Well GW-5	Predicted Impact- Percent Change in Concentration over Baseline Conditions[1]	DEQ-7 Groundwater Standard or SMCL
pH	6.6	7.8	NC	NC	6.5 – 8.5*
Calcium	96	81	90.3357	(-5%) -6%	--
Magnesium	21	25	22.5105	(6%) 7%	--
Sodium	20	17	18.8671	(-5%) -6%	--
Potassium	ND	6.5	NC	(NC) NC	--
Sulfate	281	141	228.1329	(-15%) -19%	250*
Chloride	6	2.4	4.6406	(-19%) -23%	250*
Fluoride	0.18	0.2	0.1876	(3%) 4%	4.0
Nitrate+Nitrite	0.85	0.008	0.5320	(-31%) -37%	10
Cyanide, total	<0.01	<0.01	<0.01	NCB	0.2
Arsenic	<0.005	0.006	<0.0038	NCB[2]	0.01
Cadmium	0.007	0.00005	0.0044	(-31%) -37%	0.005
Copper	<0.01	0.002	<0.0039	NCB	1.3
Iron	0.55	0.4	0.4934	(-8%) -10%	0.3*
Lead	0.03	0.002	0.0194	(-29%) -35%	0.015
Manganese	0.54	0.1	0.3738	(-25%) -31%	0.05*
Silver	<0.005	0.002	<0.0023	NCB	0.1
Zinc	0.41	0.005	0.2571	(-31%) -37%	2.0

Notes:

1 Values in parentheses are for Alternative 1 (see Table 3.6-8) and are provided for the purpose of comparing alternatives.
2 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL for this constituent is available

3.6.3.3 Alternative 3 – Agency Modified Alternative

Impacts to groundwater for Alternative 3 would be similar to the impacts discussed for Alternative 2, except for those impacts described in this section. Project modifications and mitigations included as part of Alternative 3 that relate to groundwater resources include:

- Instead of using a pipe to divert Clancy Creek as in Alternative 2, Montana Tunnels would construct an open-flow channel to convey flow from Clancy Creek around the rim of the mine pit. The characteristics of the constructed channel would be similar to the present Clancy Creek drainage, and would convey up to the 1 in 20 year return period 24 hour storm event.
- Montana Tunnels would conduct an operational verification program to monitor tailings storage facility leachate quality and pit water quality during the 5-year closure period to verify estimates of seepage and pit lake water quality made in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Water quality samples from the combined drains and pit lake would be collected using the laboratory analytical list provided in **Table 3.6-3** and pit lake elevations provided in **Table 2.2-3**. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The existing models would be calibrated using newly collected operational data. The calibrated models would be rerun and if necessary, pit water or tailings storage facility leachate would be managed or treated, as appropriate. At the end of the 5-year monitoring period the agencies would coordinate with Montana Tunnels to establish a monitoring program that would be appropriate for the conditions at the time.
- At the end of the 5-year closure period Montana Tunnels would breach the south pond liner and bury the south pond only if pond water quality meets DEQ-7 standards. If the operational verification program indicated tailings storage facility seepage was worse than predicted in this EIS, the pond liner would not be breached and tailings storage facility seepage would continue to be pumped into the pit or treated, if necessary. Additionally, the recovery well system would be operated to prevent contaminant migration in groundwater, if necessary.

Impacts for Alternative 3 would be similar to the impacts discussed for Alternative 2, except for the differences described below.

Groundwater Quantity - Alternative 3

M-Pit Area

The water-balance model for Alternative 3 assumed that Clancy Creek flow would not be used to augment the pit filling process and the formation of a pit lake after mining.

Because surface water flow from Clancy Creek would not be diverted to the mine pit after the cessation of mining, the time required for the pit lake to reach equilibrium for Alternative 3 would increase by several decades compared to Alternative 2 (Montana Tunnels 2007). Seepage from the M-Pit Lake (360 gpm) to groundwater in the Spring Creek drainage would be less than Alternative 2 because no surface water flow other than flows greater than the 1 in 20 year return period 24 hour storm event would enter the mine pit from Clancy Creek. For Alternative 2, a portion of Clancy Creek would continue to flow into the pit after equilibrium. Similar to Alternative 2, no surface water outflow from the pit lake after mining would be anticipated for Alternative 3.

Groundwater Quality - Alternative 3

Mine Pit Area

The pit filling model for Alternative 3 assumed that Clancy Creek would not be used to augment the pit filling process after mining and this flow would not be available for dilution in the pit lake as it fills. Baseline groundwater quality in the Spring Creek drainage near monitoring well GW-5 and M-Pit lake water quality model results for the M-Pit lake are presented in **Table 3.6-12**. The concentrations of constituents in the M-Pit lake for Alternative 3 would be about 14 percent greater than the concentrations of constituents in the M-Pit lake for Alternative 2 because for Alternative 3, flow in Clancy Creek would not be available for dilution.

A mixing model was constructed by the agencies to evaluate the impact of 360 gpm (0.8 cfs) of seepage from the M-Pit lake on groundwater quality near monitoring well GW-5. The impact would not occur until about two centuries after mining ceases. The model calculated the new groundwater concentration and the percent increase or decrease in concentrations of constituents in groundwater at this location. Model results presented in **Table 3.6-12** indicate that all DEQ-7 groundwater standards would be met.

The mixing model indicates that the concentrations of sulfate, cadmium, and lead in groundwater would improve to below DEQ-7 groundwater standards or the SMCL. No adverse long-term seepage impacts from the pit lake on groundwater quality in the Spring Creek drainage would be anticipated for Alternative 3.

TABLE 3.6-12
AGENCY MODIFIED ALTERNATIVE
IMPACTS RELATED TO 360 GPM OF M-PIT SEEPAGE TO GROUNDWATER

Parameter	Baseline Groundwater Quality from Monitoring Well GW-5[a] October 1984	Model Predicted M-Pit Lake Water Quality at Elevation 5,625 feet	Model Predicted Impact - Concentration in Groundwater near Monitoring Well GW-5	Model Predicted Impact- Percent Change in Concentration over Baseline Conditions[1]	DEQ-7 Groundwater Standard or SMCL
pH	6.6	7.5	NC	NC	6.5 – 8.5*
Calcium	96	58.64	66.05	(0%; -38%) -31%	--
Magnesium	21	22.91	22.53	(2%; -9%) 7%	--
Sodium	20	11.3	13.02	(0%; -41%) -35%	--
Potassium	ND	17.42	ND	(NC; NC) NC	--
Sulfate	281	112.28	146	(-2%; -53%) -48%	250*
Chloride	6	4.09	4.47	(-2%; -36%) -26%	250*
Fluoride	0.18	0.28	0.26	(13%; 13%) 45%	4.0
Nitrate+Nitrite	0.85	0.33	0.43	(-2%; -55%) -49%	10
Cyanide, total	<0.01	0.00081	<0.0016	NCB	0.2
Arsenic	<0.005	0.005	<0.0045	NCB[2]	0.01
Cadmium	0.007	0.00016	0.0015	(-6%; -78%) -78%	0.005
Copper	<0.01	0.0064	<0.0061	NCB	1.3
Iron	0.55	0.24	0.301	(-3%; -54%) -45%	0.3*
Lead	0.03	0.0022	0.008	(-6%; -75%) -74%	0.015
Manganese	0.54	0.151	0.23	(1%; -59%) -58%	0.05*
Silver	<0.005	0.0021	<0.0022	NCB	0.1
Zinc	0.41	0.012	0.09	(-7%; -78%) -78%	2.0

Notes:
1 Values in parentheses are for Alternatives 1 and 2, respectively, (see Table 3.6-8). These values are provided for the purpose of comparing alternatives.
2 There has been no historic increase in the concentration of arsenic during 20 years of mining at MTMI based on data from existing monitoring reports.
All units are milligrams per liter, except pH which is in standard units.
Less than detection limit values were set to one-half the detection limit for all statistical calculations.
Human health standards for groundwater are from DEQ-7, except those values with asterisk (*) which are SMCL.
a = Monitoring well GW-5 is the most representative downgradient monitoring well.
Shaded cell = Indicates the concentration exceeds a DEQ-7 groundwater standard or an SMCL.
NC = Not calculated for pH because it is a logarithmic value.
NCB = The percent change in the concentration of the constituent could not be predicted because the baseline concentration of the constituent was less than the laboratory detection limit value.
ND = No Data
SMCL = Secondary maximum contaminant level
< = Less Than
-- = No DEQ-7 groundwater standard or SMCL for this constituent is available

The mixing model indicates that the concentration of manganese (58 percent decrease) would exceed the SMCL, but would be less than in 1984.

If, based on the results of the operational verification program, the mine pit water quality was worse than model-predicted water quality, actions would be taken to improve the water quality of pit inflow (possibly through treatment) or reduce the volume of poor quality water entering the mine pit. The resulting pit lake water quality would depend on a number of factors such as flow rate and treatment requirements set by the agencies.

Tailings Storage Facility Area

If, based on the results of the operational verification program, tailings storage facility leachate was worse than model-predicted water quality, actions would be taken to prevent migration of seepage from the tailings storage facility (*e.g.*, not breach the south pond liner and continue pumping the downgradient recovery well system). If necessary, tailings storage facility seepage could also be treated prior to discharge to either the mine pit or groundwater.

3.7 Surface Water

This section discusses the surface water analysis methods used, the affected environment under 2007 conditions, and the environmental consequences for Alternatives 1, 2, and 3 as they relate to surface water hydrology. The affected environment for surface water resources was discussed in the 1986 final EIS on page III-8 (DSL 1986). The impacts to surface water resources from permitting the original Montana Tunnels project were discussed in the 1986 final EIS on page IV-4. The analysis methods for this EIS are summarized below.

3.7.1 Analysis Methods

Analysis Area

The analysis area for surface water resources includes the Clancy Creek, Spring Creek, and Pen Yan Creek drainages (**Figure 3.6-2**). Clancy Creek and Spring Creek are intermediate in size and are both tributaries to Prickly Pear Creek. Pen Yan Creek is small in size and is an intermittent tributary of Spring Creek. A map of the study area showing all major drainages as well as the historic mines in the Corbin-Wickes mining district is provided as Figure III-1 of the 1986 final EIS (DSL 1986), and **Figure ES-1** of this EIS.

Information Sources

Information for the analysis of surface water resources in the Montana Tunnels area was found in the application for amendment to Montana Tunnels Operating Permit 00113 and related technical reports contained therein (Montana Tunnels 2007). Surface water quality standards were obtained from DEQ publication DEQ-7 (DEQ 2006a). SMCLs for public water supply systems were obtained from 40 CFR Part 143.3. More recent hydrologic data collected as part of the application for the operating permit amendment were cross-checked with information provided in the 1986 final EIS (DSL 1986).

Methods of Analysis

Surface water flow and quality were analyzed using standard flow equations and hydrologic water balance relationships (Loucks 1981).

Water-balance models were constructed by Montana Tunnels and verified by the agencies to estimate the filling time for various pit configurations and alternatives, and to predict the water quality characteristics of the pit lake after mining (Montana Tunnels 2007). Water-balance models are not currently calibrated, but could be calibrated

(verified) once mining ceases and pit lake elevation data and pit lake water quality data are collected. The existing uncalibrated water-balance models should be considered screening tools that provide quantitative results to support conclusions qualitatively.

Potential surface water quality impacts related to the mine area, including the pit lake after mining, the tailings storage facility, and the waste rock storage area, were analyzed for Clancy Creek, Pen Yan Creek, and Spring Creek, as appropriate. Surface water quality data and results from analysis of impacts were evaluated against DEQ-7 surface water quality standards (DEQ 2006a), or against SMCLs contained in 40 CFR Part 143, if no DEQ-7 standard was available. SMCLs are non-enforceable guidelines regulating contaminants in public water systems that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. For the purpose of this EIS, a comparison of surface water quality data to SMCL was presented in order to provide an evaluation that uses a consistent benchmark for comparison. This benchmark may not be appropriate from the perspective of enforcement by DEQ because there may not be an associated public water supply.

Clancy Creek, Pen Yan Creek and Spring Creek are classified by DEQ as B-1 streams, meaning that beneficial uses for "drinking, culinary and food processing (after conventional treatment), bathing, swimming and recreation, growth and propagation of salmonids and aquatic life, waterfowl and furbearers, agriculture and industrial purposes" must be maintained. Applicable surface water quality standards for Clancy Creek, Pen Yan Creek, and Spring Creek include DEQ-7 human health standards, as well as acute and chronic aquatic life standards.

Statistical analyses were performed in the evaluation of surface water quality data. All values that were below detection limits were set equal to one-half the detection limit value for the purpose of statistical evaluation. Flow rates for all analyses are presented in both gpm and cfs. Concentrations are presented in mg/L.

An adverse impact is defined as an impact that reduces available flow or that increases the concentration of a constituent in surface water above the DEQ-7 standard. A beneficial impact is defined as an impact that increases available flow, or that decreases the concentration of constituents in surface water, thus improving some aspect of water quantity or quality.

A short-term impact is defined as an impact that would last no longer than until the end of the 5-year closure period. A long-term impact is defined as an impact that would persist beyond the 5-year closure period.

3.7.2 Affected Environment

3.7.2.1 Water Quantity

Flows in Clancy Creek, Pen Yan Creek, and Spring Creek have been measured at several surface water monitoring stations for various periods of record since 1984. **Figure 3.7-1** provides the locations of all surface water monitoring stations in the analysis area. Flow characteristics for each stream are provided in the following sections.

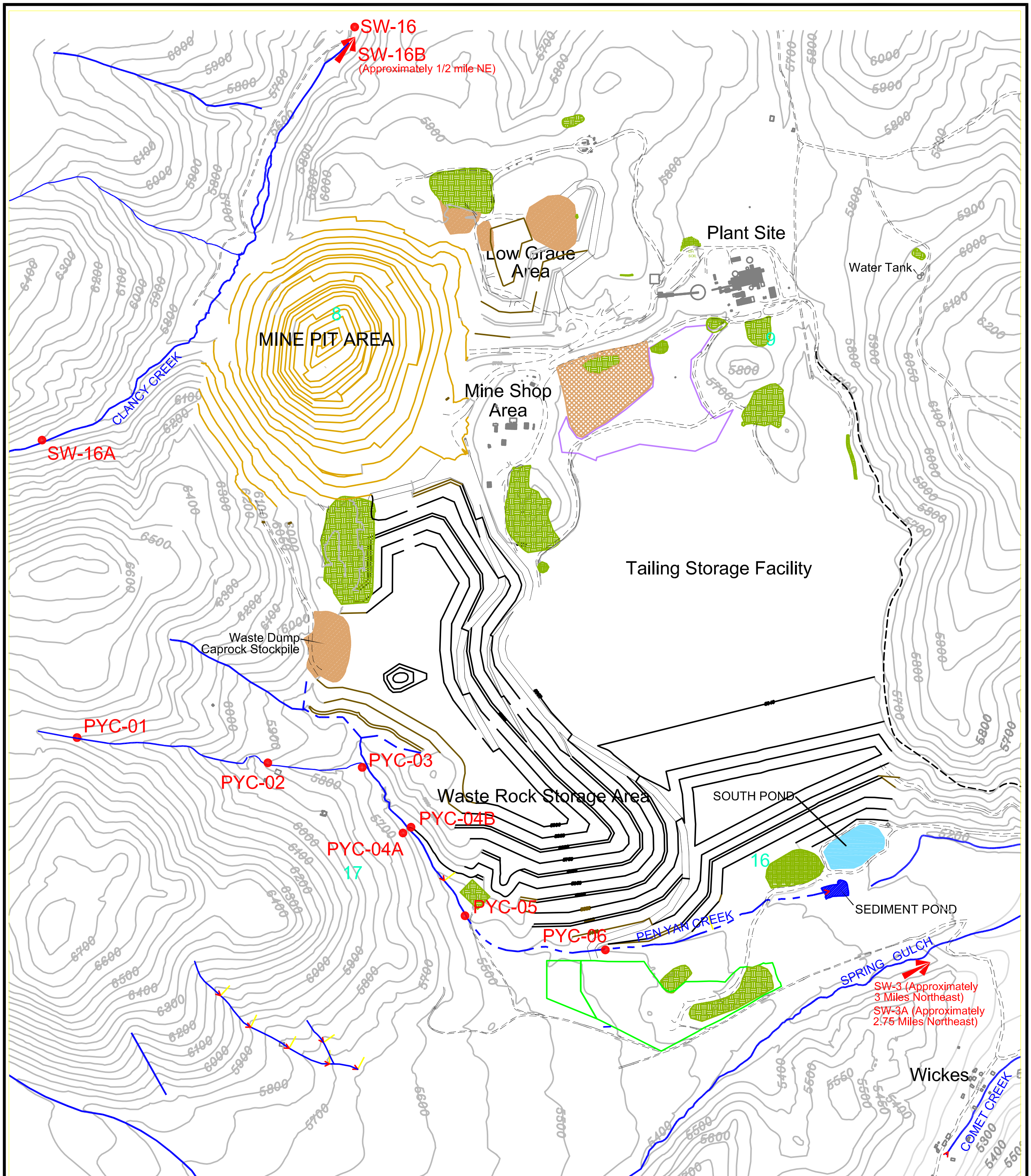
Clancy Creek

Clancy Creek is a small perennial stream flowing northwest of the mine pit (**Figure 3.7-1)**. Elevations within the Clancy Creek drainage basin range from approximately 7,800 feet in its headwaters to 5,550 feet at the operating permit boundary. The stream originates from springs and historic mine adit flows approximately 1 mile upstream of the Montana Tunnels Mine pit in a steep, conifer-forested canyon with a drainage area of approximately 1,000 acres. The stream channel is flanked by wooded and herbaceous riparian areas with moderate sinuosity and a moderate to steep gradient (Montana Tunnels 2007).

The floor of the Clancy Creek valley broadens to widths of approximately 200 to 400 feet adjacent to the mine pit. The steam channel courses through a meadow area and is flanked with an alder and willow fringe. Farther downstream, an unnamed ephemeral drainage tributary enters the meadow from the northwest. Flows from ephemeral drainages into Clancy Creek are generally observed during snowmelt runoff periods in the spring (Montana Tunnels 2007).

The Clancy Creek channel continues through a broad meadow area downstream of the mine pit. Clancy Creek begins to lose flow to groundwater as it follows its course to a confluence with Kady Gulch, approximately one-half mile downstream of the pit. During drought years, flows in Clancy Creek between the mine and Kady Gulch have ceased during late summer and through winter months (Montana Tunnels 2007).

Flow in Clancy Creek has been measured at two surface water monitoring stations (SW-16 and SW-16B). Surface water monitoring station SW-16 is located just downstream of the mine pit; monitoring station SW-16B is located 1 mile downstream of the pit, and about one-half mile downstream of the confluence of Kady Gulch with Clancy Creek (**Figure 3.7-1)**. Flow has been measured quarterly since 1986 at station SW-16B; flow at station SW-16 has been measured only intermittently from 1992 through 2003.



LEGEND

- Existing Soil or Gravel Stockpile
- Cap Rock Stockpile
- Natural Drainage
- Existing Constructed Drainage
- Surface Water Sample Locations

Note: Surface configuration is for Alternative 1 - No Action Alternative (L-Pit)

N

500 0 1500
Feet
Source: Apollo Gold, Inc.

FIGURE 3.7-1
Surface Water Monitoring Sites

Montana Tunnels Project

Flow in Clancy Creek is generally highest during late spring and early summer (May through June), when rain and snowmelt contribute to runoff. Flow generally decreases throughout the remainder of the year. Flow at monitoring station SW-16B ranged from 0 gpm (0 cfs) to 1,279 gpm (2.85 cfs) for the 1986 to 2005 period of record. The average flow for all measurements at station SW-16B was 251 gpm (0.56 cfs) (Montana Tunnels 2007).

Flow at station SW-16 was measured several times during the period 1992 through 1994, once in 1995 and once again in 2003. Measured flows ranged from 0 gpm (0 cfs) to 1,333 gpm (2.97 cfs). The average flow for all measurements was 655 gpm (1.46 cfs). Montana Tunnels estimates that the long-term annual average flow in Clancy Creek in the vicinity of the mine pit is about 100 gpm (0.22 cfs). The 1-in-5-year return period flow for Clancy Creek near station SW-16 was estimated to be 6,732 gpm (15 cfs) (Montana Tunnels 2007).

Pen Yan Creek

Pen Yan Creek is a small ephemeral and intermittent stream that borders the waste rock storage area on the southwest side of the mine site and along the southern side of the existing mine facilities (**Figure 3.7-1)**. The Pen Yan Creek channel joins Spring Creek via Spring Gulch near the southwest corner of the operating permit area. The reaches of Pen Yan Creek and Spring Gulch that cross the Wood Chute Flats glacial outwash have no defined channel and no observed flows. Elevations within the Pen Yan Creek drainage range from approximately 5,800 feet in its headwaters to approximately 5,200 feet at the confluence with Spring Gulch. Much of the drainage basin of Pen Yan Creek consists of existing waste rock piles. Adits from the historic Washington Mine discharge mine water into the Pen Yan Creek channel.

During base flow conditions in October 2002, the Pen Yan Creek channel showed a small amount of flow originating upstream of the Washington Mine site near monitoring station PYC-01 (1.5 gpm [0.0033 cfs]). The channel gained flow near station PYC-02 (5 gpm [0.011 cfs]), then lost flow at station PYC-03 (2 gpm [0.0045 cfs]) before disappearing entirely in the historic mine tailings piles between stations PYC-03 and PYC-04. At station PYC-04, a diversion pipe discharged 50 gpm (0.11 cfs) of water to a dry streambed. The discharge pipe appeared to collect flow from several adits at the head of the Washington Mine, routing the water around the mine waste and tailings pile areas to discharge at station PYC-04. The quantity of flow at station PYC-05 was similar to PYC-04 (42 gpm [0.094 cfs]). Farther downstream, the Pen Yan Creek channel lost flow at station PYC-06 (4.4 gpm [0.0098 cfs]), and then disappeared entirely, apparently infiltrating to the underlying glacial outwash colluvium and local groundwater system a short distance downstream of PYC-06.

A comparison of flows at selected surface water stations in the Pen Yan Creek drainage for both base flow (October 2002) and high flow (June 2003) conditions is provided in **Table 3.7-1.** These data suggest there are similarities in both flow regimes. Most channel flow infiltrates to groundwater at station PYC-06.

TABLE 3.7-1
SURFACE WATER FLOW DATA FOR PEN YAN CREEK

Measuring Location	Date	
	October 16, 2002	June 3, 2003
PYC-01	1.5 (0.0033)	19.7 (0.044)
PYC-02	5 (0.011)	50.3 (0.11)
PYC-03	0 (0)	0 (0)
PYC-04	50 (0.11)	38.2 (0.085)
PYC-06	4.4 (0.0098)	19.7 (0.44)

Note: Flows presented in gallons per minute. Conversion to cubic feet per second (cfs) presented in parentheses.

Spring Creek

The origin of Spring Creek is a series of springs located about 2.5 miles east of the Montana Tunnels mill site. The creek then flows a distance of about 3 miles to its confluence with Prickly Pear Creek at the town of Jefferson City, Montana. Flows in Spring Creek are typical of a spring-fed stream and generally range between 449 gpm (1 cfs) and 1,795 gpm (4 cfs). Typical flows in the perennial section of Spring Creek vary seasonally and usually increase toward the late summer and fall months as latent groundwater recharge from snowmelt replenishes the springs from a large upgradient basin area (22 square mile area above Corbin [DSL 1985]). Large rain events produce little flow variability in the stream, because the origin of the spring-fed stream is in a long, broad valley of deep gravel that readily assimilates large precipitation events to groundwater and attenuates the effects of storm runoff.

Flows in Spring Creek have been measured at two monitoring stations (SW-3 and SW-3A) **(Figure 3.7-1).** The current surface water monitoring station for Spring Creek (SW-3A) is about 2,500 feet downstream of the origin of the first springs on Spring Creek. Due to access issues involving land ownership, the original monitoring station on Spring Creek (SW-3) was moved ¼-mile upstream to its present location in mid-2000. Measured flows at upstream station SW-3A are typically less than flows at downstream station SW-3, most likely because additional springs produce a gaining stream through the lower section of the creek (Montana Tunnels 2007).

Measured flows at Spring Creek station SW-3 ranged from 0 gpm (0 cfs) to 3,630 gpm (8.09 cfs) during the 1986 to 2000 period of record. The average flow at station SW-3 for all measurements during this period of record was 1,270 gpm (2.83 cfs). Flow at Spring

Creek station SW-3A ranged from 0 gpm (0 cfs) to 821 gpm (1.83) cfs during the 2000 to 2004 period of record. The average flow at station SW-3A for all measurements during the 2000 to 2004 period of record was 507 gpm (1.13 cfs) (Montana Tunnels 2007).

Montana Tunnels maintains a pump station on lower Spring Creek to divert 1,000 gpm (2.2 cfs) of surface water for mine operations. The point of diversion is approximately 1 mile downstream of station SW-3A.

3.7.2.2 Water Quality

Water quality conditions for Clancy Creek, Pen Yan Creek, and Spring Creek have been measured at various locations and at various times since 1984. **Figure 3.7-1** provides the locations of all surface water monitoring stations. A discussion of water quality is provided in the following sections for each drainage.

Clancy Creek

In general, Clancy Creek exhibits good water quality in the area of the mine, even though there is some effect from historic adit drainage introduced into the creek at an upstream tributary location. Clancy Creek water is soft to moderately hard with corresponding low levels of dissolved solids, total alkalinity, and metals, and near-neutral pH. On average, the metals concentrations appear to be higher when the flow volume is lower in August through April (Montana Tunnels 2007). Water quality of Clancy Creek has been periodically monitored at station SW-16 and SW-16B (**Figure 3.7-1**).

A summary of selected water quality data collected at monitoring stations SW-16 and SW-16B is provided in **Table 3.7-2** and **Table 3.7-3**, respectively. The concentrations of metals meet DEQ-7 surface water quality standards for human health, except for cadmium (at station SW-16) and arsenic (at station SW-16B) which have sometimes exceeded the standard. The concentrations of cadmium, copper, and lead (station SW-16), and cadmium, copper, lead, and zinc (station SW-16B) have sometimes exceeded the DEQ-7 acute or chronic aquatic water quality standards. The concentrations of manganese have exceeded the SMCL at both monitoring stations. It is generally not unusual for surface water flowing through areas of high mineralization to exhibit variations in metals concentrations, especially during high flow events characterized by elevated turbidity.

TABLE 3.7-2
SURFACE WATER QUALITY DATA FOR CLANCY CREEK AT STATION SW-16

	Number of Samples	Mean[a]	Minimum[a]	Maximum	AA	AC	HH or SMCL
pH	5	NC	6.7	8	-	-	6.5-8.5*
SC	5	201.6	181	212	-	-	-
TSS	3	8.7	2	14	-	-	-
TDS	2	138	133	142	-	-	500*
Total Hardness as $CaCO_3$	4	98	95	104	-	-	-
Sulfate	4	41	36	49	-	-	250*
Arsenic TR	2	<0.005	<0.005	<0.005	0.34	0.15	0.01
Cadmium TR	1	0.006	0.006	0.006	0.00209	0.00027	0.005
Copper TR	2	<0.01	<0.01	<0.01	0.01374	0.00917	1.3
Lead TR	2	<0.0125	<0.01	0.02	0.07957	0.00310	0.015
Manganese TR	2	0.25	0.13	0.37	-	-	0.05*
Zinc TR	2	0.06	0.06	0.06	0.11778	0.11778	2.0

Notes:
All concentrations are in milligrams per liter, except pH (standard pH units).
a = Less than detection limit values were set to one-half the detection limit for all statistical calculations.
* = SMCL
AA = DEQ-7 acute aquatic life standard based on 98 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 98 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
- = No DEQ-7 numerical standard or SMCL is available.
NC = Not calculated.
SC = Specific conductivity
SMCL = Secondary maximum contaminant level
TR = Samples analyzed following a "total recoverable" digestion procedure (DEQ-7)
TSS = Total suspended solids
TDS = Total dissolved solids
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

.

TABLE 3.7-3 SURFACE WATER QUALITY DATA FOR CLANCY CREEK AT STATION SW-16B							
	Number of Samples	Mean[a]	Minimum[a]	Maximum	AA	AC	HH or SMCL
pH	73	NC	6.1	8.2	-	-	6.5-8.5*
SC	74	189	121	402	-	-	-
TSS	24	11	2	42	-	-	-
TDS	36	121	57	267	-	-	500*
Total Hardness as $CaCO_3$	57	82.7	18.6	167	-	-	-
Sulfate	58	38	20	77	-	-	250*
Arsenic TR	37	<0.00323	<0.003	0.015	0.34	0.15	0.01
Cadmium TR	37	<0.00057	<0.0001	0.004	0.00176	0.00024	0.005
Copper TR	34	<0.0128	<0.001	0.068	0.01171	0.00793	1.3
Lead TR	37	<0.0086	<0.003	0.07	0.06411	0.00250	0.015
Manganese TR	28	0.25	0.009	2.49	-	-	0.05*
Zinc TR	35	<0.051	<0.01	0.21	0.10200	0.10200	2.0

Notes:

All concentrations are in milligrams per liter, except pH (standard pH units).
a = Less than detection limit values were set to one-half the detection limit for all statistical calculations.
* = SMCL
AA = DEQ-7 acute aquatic life standard based on 82.7 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 82.7 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
- = No DEQ-7 numerical standard or SMCL is available.
NC = Not calculated.
SC = Specific conductivity
SMCL = Secondary maximum contaminant level
TR = Samples analyzed following a "total recoverable" digestion procedure (DEQ-7)
TSS = Total suspended solids
TDS = Total dissolved solids
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

Clancy Creek is classified by DEQ as a B-1 stream, meaning that beneficial uses for "drinking, culinary and food processing (after conventional treatment), bathing, swimming and recreation, growth and propagation of salmonids and aquatic life, waterfowl and furbearers, agriculture and industrial purposes" must be maintained. Existing water quality in Clancy Creek is such that some of the beneficial uses are impaired. As a result, Clancy Creek is listed on the DEQ 303(d) list for impaired waters. The specific uses that Clancy Creek does not support are aquatic life, growth and propagation of salmonids, and drinking water. The probable causes of impairment are contamination by various metals, channel and habitat alterations, and siltation. The probable sources of these causes are agriculture, resource extraction (mining) and roads.

Pen Yan Creek

Comprehensive surface water quality data for Pen Yan Creek were collected at stations PYC-01, PYC-02, PYC-04 and PYC-06 during October 2002 and June 2003 to support the Montana Tunnels Mine Expansion application. These data were the most comprehensive and representative data set for the Pen Yan Creel drainage prior to recent mine waste reclamation activities. Surface water quality data were also collected near the end of a pipe that discharges water from the Washington Mine (station PYC-04A), and near a discharge that flows through the upstream tailings mass (station PYC-04B). A summary of selected water quality data collected at these surface monitoring stations is provided in **Table 3.7-4.** These data indicate that detectable concentrations of some metals are present in Pen Yan Creek upstream of the Washington Mine (station PYC-01). Specifically, in October 2002 station PYC-01 exhibited detectable concentrations of arsenic, cadmium, copper, lead, manganese, and zinc. No DEQ-7 surface water standards were exceeded.

Immediately downstream of the Washington Mine site at station PYC-02, water quality impacts to Pen Yan Creek from acidic discharges and mine waste are apparent. Data for common ions and physical parameters at these two monitoring stations indicate that sulfate increased from 7 to 453 mg/L, and alkalinity decreased from 72 to 34 mg/L. While pH remained neutral, the concentrations of some metals increased to levels above DEQ-7 standards, in particular cadmium, copper, manganese, and zinc. The Washington Mine adit pipe discharge at monitoring station PYC-04 also exhibited elevated concentrations of arsenic, cadmium, manganese, and zinc above DEQ-7 standards or the SMCL, as appropriate.

Concentrations of constituents further downstream at station PYC-06 were generally lower than at station PYC-04, except for cadmium and zinc.

TABLE 3.7-4
SURFACE WATER QUALITY DATA FOR PEN YAN CREEK
AT STATIONS PYC-01, PYC-02, PYC-04, AND PYC-06

Station	Sample Date	pH	Arsenic TR	Cadmium TR	Copper TR	Lead TR	Mn TR	Zinc TR
PYC-01	10-16-2002	6.5	0.008	0.0001	0.004	0.011	0.6	0.02
PYC-01	6-3-2003	ND	0.004	<0.0001	0.002	<0.003	<0.01	0.01
PYC-02	10-16-2002	7.2	0.006	0.0427	0.028	0.004	4.61	17.1
PYC-02	6-3-2003	ND	0.036	0.137	0.177	0.036	13.9	41.2
PYC-04	10-16-2002	7.3	0.241	0.0012	<0.001	<0.003	2.44	1.04
PYC-04A[a]	6-3-2003	ND	0.188	<0.0001	<0.001	<0.003	1.82	0.52
PYC-04B[b]	6-3-2003	ND	0.102	0.143	0.146	0.02	10.6	45.1
PYC-06	10-16-2002	8	0.029	0.0033	0.001	<0.003	0.11	1.46
PYC-06	6-3-2003	--	0.035	0.06	0.009	<0.003	4.98	18.3
AA		-	0.34	0.00873	0.05168	0.47682	-	0.38783
AC		-	0.15	0.00076	0.03050	0.01858	-	0.38783
HH		-	0.01	0.005	1.3	0.015	-	2.0
SMCL		6.5-8.5	-	-	-	-	0.05	-

Notes:

All concentrations are in milligrams per liter, except pH (standard pH units).
The average total hardness for Pen Yan Creek was 473 mg/L (Montana Tunnels 2007).
a = Station PYC-04A is located near the end of a pipe that discharges water from the Washington Mine.
b = Station PYC-04B is located near a discharge that flows through the upstream tailings mass.
AA = DEQ-7 acute aquatic life standard based on 400 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 400 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
Mn = Manganese
- = No DEQ-7 numerical standard or SMCL is available.
SC = Specific conductivity
SMCL = Secondary maximum contaminant level
TR = Samples analyzed following a "total recoverable" digestion procedure (DEQ-7)
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

Evaluation of the available flow and water quality data for Pen Yan Creek suggests the majority of the load for cadmium, copper, manganese, zinc, and sulfate occurs between stations PYC-01 and PYC-02 and is likely associated with mine waste situated at the Washington Mine. In addition, the majority of the arsenic load occurs between stations PYC-02 and PYC-04 and is likely attributable to the adit pipe discharge to the channel at this location. Lastly, the metals load in surface water generally decreased between stations PYC-04 and PYC-06. Flows in this reach decreased by a factor of ten and loads of arsenic and manganese decreased by a factor of 100, suggesting that precipitation of iron and manganese oxides and co-precipitation of arsenic occurs through this reach of stream (Montana Tunnels 2007).

In summary, water quality data from monitoring stations located in Pen Yan Creek downstream of the Washington Mine exhibit some exceedances of DEQ-7 surface water standards for a variety of metals, including arsenic, cadmium, copper, lead, and zinc. Manganese exceeds the SMCL. Pen Yan Creek is classified as a B-1 stream, but has not been listed on the DEQ 303(d) list for impaired water, possibly because of its small size and intermittent nature of flow.

Spring Creek

Spring Creek is recharged by a drainage that has been historically affected by numerous previous mining disturbances that predate activities by Montana Tunnels, including the Alta Mountain, Minah, Washington, and Blue Bird mines and the Wickes smelter area. Water quality monitoring has been conducted on a quarterly basis for Spring Creek at surface water stations SW-3 and SW-3A. The period of record for data collection is 1984 to 2000 for station SW-3 and 2000 to 2006 for station SW-3A. A summary of selected water quality data is provided in **Table 3.7-5.**

Data provided in **Table 3.7-5** indicate that Spring Creek contains moderately hard to very hard water (maximum hardness of 377 mg/L). The concentrations of arsenic, cadmium, and lead have sometimes exceeded the DEQ-7 surface water standard for human health in some samples, and the concentrations of cadmium, copper, and lead have at times exceeded either the DEQ-7 acute or chronic aquatic life standard.

Spring Creek is classified B-1 by DEQ and is on the 303(d) list for impaired water. Water quality in Spring Creek does not support aquatic life, growth, and propagation of salmonids, and drinking water. The probable cause for the listing is dewatering, habitat degradation and alteration, contamination by various metals, and degradation of the riparian zone caused by agriculture, mining, and channelization.

TABLE 3.7-5 SURFACE WATER QUALITY DATA FOR SPRING CREEK AT STATIONS SW-3 AND SW-3A (DATA COMBINED)							
	Number of Samples	Mean[a]	Minimum[a]	Maximum	AA	AC	HH
pH	86	NC	6.2	8	-	-	6.5-8.5*
SC	86	492	363	774	-	-	-
TSS	27	<10	<10	<10	-	-	-
TDS	47	387	157	603	-	-	500*
Total Hardness	86	229	159	377	-	-	-
Sulfate	85	171	107	360	-	-	250*
Arsenic TR	82	<0.0127	<0.003	0.29	0.34	0.15	0.01
Cadmium TR	83	<0.00125	<0.001	0.008	0.00493	0.00050	0.005
Copper TR	81	<0.0052	<0.001	0.04	0.03056	0.01894	1.3
Lead TR	83	<0.0088	<0.001	0.07	0.023442	0.00914	0.015
Manganese TR	40	<0.078	<0.005	0.23	-	-	0.05*
Zinc TR	82	0.12	0.04	0.62	0.24177	0.24177	2.0

Notes:
All concentrations are in milligrams per liter, except pH (standard pH units).
a = Less than detection limit values were set to one-half the detection limit for all statistical calculations.
* = SMCL
AA = DEQ-7 acute aquatic life standard based on 229 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 229 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
- = No DEQ-7 numerical standard or SMCL is available.
NC = Not calculated
SC = Specific conductivity
TR = Samples analyzed following a “total recoverable” digestion procedure (DEQ-7)
TSS = Total suspended solids
TDS = Total dissolved solids
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

3.7.3 Environmental Consequences

3.7.3.1 Alternative 1 – No Action Alternative (L-Pit)

Environmental consequences related to surface water quantity and water quality for Alternative 1 are discussed in the following subsections for each of the three drainages in the mine permit area.

Water Quantity

Clancy Creek

The 1986 final EIS evaluated pit filling after mining and the impact of the mine pit on flows in Clancy Creek. The 1986 final EIS concluded that after mining operations cease, the mine pit would begin to fill with water and reach equilibrium conditions after several centuries. The mine pit would not fill completely, and there would be no surface water discharge from the pit. The final EIS also concluded that long-term groundwater seepage from the Clancy Creek drainage into the pit would be about 10 gpm (0.02 cfs) to 90 gpm (0.2 cfs) (DSL 1986).

A water-balance model to simulate the rate of pit filling and pit lake water quality for Alternative 1 after mining was constructed by Montana Tunnels, and verified by the agencies (Montana Tunnels 2007). For Alternative 1, after mining ceases, flow from Clancy Creek would not be used to fill the mine pit to create a pit lake.

The model predicts that the pit lake would reach equilibrium almost two centuries after mining ceases at the 5,610-foot elevation, approximately 60 feet from the lowest rim of the pit (5,670 feet). The pit lake at equilibrium would not overtop the pit, and no surface water outflow from the lake would be anticipated. Thus, the predicted pit-filling scenario for the L-Pit mine would be similar to what was previously predicted in the 1986 final EIS (DSL 1986).

For Alternative 1, the Clancy Creek channel in the vicinity of the mine pit would not be excavated by expansion of the pit, and the flow regime in Clancy Creek would not be altered. No impact to the Clancy Creek channel would be predicted for Alternative 1 in the foreseeable future.

A contingency channel for Clancy Creek would be constructed in the existing flood plain away from the pit highwall by the end of the 5-year closure period. This channel would not be used unless a future connection between the mine pit and the existing channel develops. A berm would separate the contingency channel and the mine pit and would accommodate maximum flood events (such as the 100-year flood) and limit the potential for migration of the Clancy Creek channel towards the pit.

For Alternative 1, a catastrophic event such as (1) the probable maximum flood (PMF), (2) geologic transformation of the landscape resulting from a large seismic event, or (3) a large mass failure of the pit highwall in the vicinity of the Clancy Creek could possibly reroute Clancy Creek into the mine pit sometime in the future. While possible, the likelihood of such a large event is considered remote in the foreseeable future (one century or less), but higher for geologic timeframes (several centuries) (Montana Tunnels 2007). If such a large event were to occur, flow entering the pit (annualized average of about 100 gpm [0.22 cfs]) would no longer be available to Clancy Creek downstream of the pit. The loss of 100 gpm flow from Clancy Creek into the mine pit, if it were to occur, would be an adverse and long-term impact.

During active mining, Montana Tunnels would continue to appropriate an estimated 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow from Clancy Creek at a point of diversion downstream of Kady Gulch from September 15 to May 15 each year as makeup water for the mill. The reduction in Clancy Creek flow during active mining would be an adverse and short-term impact.

After mining ceases, Montana Tunnels would no longer need to appropriate and divert surface water from Clancy Creek for mill makeup water. Therefore, 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow would be available to augment existing instream flows in Clancy Creek, assuming the water rights are not used for another purpose. The impact to water availability after mining ceases would be a beneficial and long-term impact.

Pen Yan Creek

The Pen Yan Creek channel would not be realigned under Alternative 1. No impact to the Pen Yan Creek channel is predicted for Alternative 1.

During active mining, storm flows and runoff from the waste rock storage area are routed to a drainage and sedimentation pond system in Pen Yan Creek. After mining ceases, storm flows would infiltrate to underlying groundwater. No impact on the overall flow regime in Pen Yan Creek is predicted for Alternative 1.

Spring Creek

During active mining, water that is currently captured by the tailings storage facility and recovery well system would continue to be used as makeup for the mill. Following the 5-year closure period, water from the tailings storage facility would be routed to a percolation pond constructed in the reclaimed south pond. This water would then infiltrate to groundwater in the Spring Gulch drainage. Some of this water would likely become part of the perennial portion of Spring Gulch, which begins as springs about 2.5 miles east of the Montana Tunnels Mine site. It is not anticipated that the additional groundwater would have a measurable effect on Spring Creek at surface water monitoring station SW-3, and no impacts to Spring Creek are predicted.

Following final reclamation and establishment of vegetation on the waste rock storage area slopes for Alternative 1, the stormwater diversion at the base of the south side of the waste rock storage area would be filled and reclaimed with soil and vegetation to match surrounding topography. Any surface runoff from the waste rock storage area surfaces would then report to the drainage location determined by the gradient of the surrounding land surfaces. Some drainage from the west and south sides of the reclaimed waste rock storage area would report to Spring Gulch to the south and east. The additional runoff would infiltrate to groundwater and would not have a measurable effect on the flow of surface water in Spring Creek. No impacts to Spring Creek are predicted.

Montana Tunnels maintains a pump station on lower Spring Creek to divert surface water for use as makeup water for the mill. An existing water rights permit entitles Montana Tunnels to pump up to 1,000 gpm (2.2 cfs) all year long from Spring Creek. The point of diversion is located approximately 1 mile downstream of surface water station SW-3A. Under Alternative 1, the appropriation of water from Spring Creek would continue during active mining. The continued appropriation of up to 1,000 gpm (2.2 cfs) from Spring Creek during active mining would be an adverse and short-term impact.

After mining ceases, the appropriation of 1,000 gpm (2.2 cfs) of water from Spring Creek would no longer occur, and the additional water would be available for other uses assuming Montana Tunnels' water rights are not used for another purpose. The increase of up to 1,000 gpm (2.2 cfs) of flow in Spring Creek after mining ceases would be a beneficial and long-term impact.

<u>Water Quality</u>

Clancy Creek

No impact to surface water quality conditions in Clancy Creek are anticipated for Alternative 1.

Pen Yan Creek

The quality of surface water in Pen Yan Creek has been impacted by historic mining activities, as discussed in Section 3.7.2.2. No other changes to surface water quality conditions in Pen Yan Creek are anticipated for Alternative 1.

Spring Creek

Historically, mine drainage from the Minah Mine, Blue Bird Mine, Washington Mine, and East Alta Mine adits has migrated to groundwater in Spring Gulch by way of the glacial outwash colluvium of Wood Chute Flats. It is likely that at least a portion of this poor quality groundwater has expressed itself as surface water flow in Spring Creek. Under Alternative 1, poor quality mine drainage would continue to impact the overall

water quality conditions in Spring Creek (**Table 3.7-5**). Existing mine drainage would continue to affect water quality in Spring Creek into the foreseeable future. The degradation of water quality in Spring Creek due to historic mine drainage would be an adverse and long-term impact.

The 2006 Water Resources Monitoring Report indicated that the concentration of sulfate in Spring Creek has exhibited a steady increase, ranging from 100 to 175 mg/L prior to 1997 to 200 to 350 mg/L since 1997 (Montana Tunnels 2007). The SMCL for sulfate is 250 mg/L. In 2002-2005, the average concentration of sulfate in tailings storage facility seepage was 623 mg/L (Montana Tunnels 2007). The 2006 Water Resources Monitoring Report indicated that the trend of increasing sulfate concentrations with time at Spring Creek surface water station SW-3A corresponds to similar trends through time at groundwater monitoring wells GW-5 and GW-8 which are located downgradient of the tailings storage facility and south pond (Montana Tunnels 2007).

Similar trends in increasing concentration over time were noted for manganese at the Spring Creek surface water SW-3A. For example, the average concentration of manganese for the 1984-1985 pre-mining baseline period was 0.03 mg/L. The average manganese concentration increased to 0.049 mg/L (average for 1996 to 2000), and then increased again to 0.12 mg/L (average for from 2000 to 2004). The SMCL for manganese is 0.05 mg/L.

For Alternative 1, the concentrations of sulfate and manganese in Spring Creek would likely remain at current levels, or possibly continue to increase during active mining. After the 5-year closure period, all seepage from the tailings storage facility would be routed to a percolation pond and groundwater, and then migrate towards Spring Creek. The concentrations of sulfate and manganese would likely temporarily increase in Spring Creek in response to this additional flow and load, as discussed below.

The tailings storage facility would continue to seep as long as the tailings mass continued to consolidate. Seepage would continue to percolate to groundwater. The amount of seepage would vary with time (Montana Tunnels 2007). Seepage flows associated with tailings consolidation would be about 181 gpm (0.40 cfs) the 5th year following cessation of mining and would decrease to 120 gpm (0.27 cfs) by the 10th year, 15 gpm (0.03 cfs) by the 25th year, and nearly zero flow by the 50th year, when the tailings would likely be fully consolidated (Montana Tunnels 2007) (See Section 3.6, Groundwater).

Because the rate of seepage would decrease with time, it is anticipated that the concentration of sulfate and manganese in surface water would also eventually decrease. The future concentrations of sulfate and manganese in Spring Creek can not be quantified, but any increases in the concentration of sulfate or manganese would be

temporary (decades). The increase in the concentration of sulfate or manganese would be an adverse long-term impact.

3.7.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Environmental consequences related to water quantity and water quality for Alternative 2 are discussed in the following subsections for each of the three drainages in the mine permit area.

Water Quantity

Clancy Creek

For Alternative 2, approximately 1,800 feet of Clancy Creek channel in the vicinity of the M-Pit would be excavated and removed during expansion of the mine pit (**Figure 2.3-2**). The flow regime in Clancy Creek would be altered, and the stream channel would be rerouted around the northwest side of the mine. Excavation and removal of 1,800 feet of the existing Clancy Creek channel would be an adverse and long-term impact.

The expansion of the mine pit would reduce the surface water catchment area for the Clancy Creek drainage by about 28 acres in the immediate area of the M-Pit mine. The average annualized loss of flow in Clancy Creek associated with the 28-acre reduction in catchment would be about 5.2 gpm (0.011 cfs) (Montana Tunnels 2007). The loss of 5.2 gpm (0.011 cfs) of flow to Clancy Creek would be an adverse and long-term impact.

During active mining, up to the maximum design flow (6,732 gpm [15 cfs]) of water in Clancy Creek upstream of the M-Pit would be conveyed in a pipe (1,200 feet long) and open-flow channel (600 feet long) system around the rim of the pit to a location just downstream of the pit. The intake structure would be located on Clancy Creek approximately 500 feet from the edge of the mine pit. The 6,732 gpm (15 cfs) design flow corresponds to the 1-in-5-year flood event (Montana Tunnels 2007). Storm flows greater than 6,732 gpm (15 cfs) would spill into the mine pit and would be managed as mine water. For example, the 1-in-20-year flood event was estimated to be 71,808 gpm (160 cfs). During the 1-in-20-year flood event, 65,076 gpm (145 cfs) would flow into the pit rather than in Clancy Creek. The potential loss of flows to Clancy Creek greater than 6,732 gpm (15 cfs) would be an adverse and short-term impact.

The Clancy Creek diversion structure would require maintenance during the operational and post-mining period to remedy potential problems that include a decrease in flow performance (clogging due to trash or sediment), failure of the diversion resulting from storm episodes, structural materials failure of the diversion, or damage to the diversion from instabilities (Montana Tunnels 2007).

During active mining, Montana Tunnels would continue to appropriate an estimated 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow from Clancy Creek at a point of diversion downstream of Kady Gulch for use as mill makeup water. The reduction of 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow in Clancy Creek during active mining would be an adverse and short-term impact.

After mining ceases, Montana Tunnels would no longer appropriate 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow from Clancy Creek. This flow would be available, assuming the water rights are not used for another purpose. The additional 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow would be a beneficial long-term impact.

After mining ceases, a portion of Clancy Creek would be diverted into the mine pit to form a pit lake. A hydrologic water-balance model to simulate the rate of pit filling for Alternative 2 was constructed by Montana Tunnels and verified by the agencies (Montana Tunnels 2007). The model predicted that the pit lake after mining would reach equilibrium at elevation at 5,625 feet, about 25 feet below the elevation of Clancy Creek. The equilibrium elevation for Alternative 2 (5,625 feet) is about 15 feet higher than for Alternative 1 (5,610 feet); this is due to higher inflows to the pit from Clancy Creek and tailings storage facility surface runoff for Alternative 2. The model indicated that the time to fill was a function of the amount of flow diverted from Clancy Creek. Filling of the mine pit with water would be expected to continue for about two centuries assuming 225 gpm (0.5 cfs) inflow from Clancy Creek and up to several decades longer assuming 0 gpm (0 cfs) inflow from Clancy Creek. Water diverted into the mine pit would no longer be available to Clancy Creek, but would instead recharge groundwater in the Spring Creek drainage.

No surface water outflow from the M-Pit lake to Clancy Creek would be anticipated at the time the lake reaches equilibrium.

The actual flow rate and volume of Clancy Creek surface water to be used to augment pit filling was not explicitly stated by Montana Tunnels in the operating permit application and depends on a number of factors that include seasonal variations in flow, assessment by Montana Tunnels of its existing water rights, consideration of downstream wetlands support, and agency technical input for various alternatives (Montana Tunnels 2007). Montana Tunnels currently holds water rights for 2,244 gpm (5 cfs) at a point of diversion on Clancy Creek upstream of the pit with a January 1 to December 31 period of use and priority date of 1872.

For Alternative 2, a catastrophic event such as (1) the probable maximum flood (PMF), (2) geologic transformation of the landscape resulting from a large seismic event, or (3) a large mass failure of the pit highwall in the vicinity of Clancy Creek could possibly reroute Clancy Creek into the mine pit sometime in the future. While possible, the likelihood of such a large event is considered remote in the foreseeable future (one

century or less), but higher for geologic timeframes (several centuries) (Montana Tunnels 2007). If such a large event were to occur, flow entering the pit (annualized average of about 100 gpm [0.22 cfs]) would no longer be available to Clancy Creek downstream of the pit. The loss of 100 gpm flow from Clancy Creek into the mine pit, if it were to occur, would be an adverse and long-term impact.

Pen Yan Creek

Approximately 3,800 feet of the existing Pen Yan Creek channel would be covered with waste rock under Alternative 2. The Pen Yan Creek drainage would be realigned around the base of the extended waste rock storage area, and the realigned channel would convey a portion of the waste rock storage area surface stormwater runoff during operations and after mining ceases. The Pen Yan Creek realignment would be designed to serve the same function as the present channel; that is, typical stream flows would infiltrate to the underlying colluvium. The realigned channel would not be lined and would be constructed in the colluvium of Wood Chute Flats to allow infiltration of stormwater into the ground which would recharge groundwater. The covering and loss of the existing Pen Yan Creek channel would be an adverse and long-term impact.

Spring Creek

During active mining, surface runoff would be captured across the mine site, and the recovery well system would be pumped immediately downgradient of the south pond when additional water is needed for the mill. The capture and use of surface runoff has occurred over the previous 20 years of mining and has not measurably affected the flow in Spring Creek. No impacts to flows in Spring Creek are anticipated during active mining as a result of using surface runoff.

Montana Tunnels maintains a pump station on lower Spring Creek to divert surface water for use as makeup water at the mill. An existing water rights permit entitles Montana Tunnels to pump up to 1,000 gpm (2.2 cfs) all year long from Spring Creek. The point of diversion is located approximately 1 mile downstream of surface water station SW-3A. Under Alternative 2, the appropriation of water from Spring Creek would continue during active mining. The continued appropriation of up to 1,000 gpm (2.2 cfs) from Spring Creek during active mining would be an adverse and short-term impact.

After mining ceases, the diversion of 1,000 gpm (2.2 cfs) of water from Spring Creek would no longer occur, and the additional water would be available for other uses, assuming Montana Tunnels' water rights are not used for another purpose. The increase of up to 1,000 gpm (2.2 cfs) of flow in Spring Creek after mining ceases would be a beneficial and long-term impact.

Water Quality

Clancy Creek

The excavation and removal of the Clancy Creek stream channel and construction of planned diversion structures and constructed stream channels in the Clancy Creek drainage under Alternative 2 would likely result in a temporary increase in soil erosion and associated load in total suspended solids (TSS) to Clancy Creek during the construction period, even if best management practices were utilized. The potential increase in TSS cannot be quantified and depends on the effectiveness of best management practices. The impact would persist until revegetation of the area was complete. The temporary increase in TSS during the construction period would be an adverse and short-term impact.

After M-Pit mining ceases, a pit lake would begin to form. The pit lake would reach equilibrium at elevation at 5,625 feet, about 25 feet below the elevation of Clancy Creek. As with the L-Pit lake, no surface water outflow from the pit lake is anticipated. No impacts to surface water quality in Clancy Creek related to the pit lake after mining are anticipated.

The Montana Tunnels Mine was permitted to be reclaimed as a pit lake in 1986. The 1986 final EIS stated that it would be difficult to accurately predict the water quality in the pit at the time the pit lake reached equilibrium (several centuries after mining). The final EIS speculated that the pit would likely contain a calcium-magnesium-sulfate type water with a pH below 7.0 (DSL 1986). Pit water was expected to contain concentrations of iron, manganese, and zinc between 0.5 mg/L and several milligrams per liter. Concentrations of aluminum, cadmium, copper, and lead were expected to range between a few hundredths to a few tenths of a milligram per liter.

Water quality monitoring in the mine pit during the last 20 years of operation has shown the water quality to be better than predicted in the 1986 final EIS. However, residual concentrations of cyanide (up to 0.042 mg/L) have been detected in the tailings storage facility seepage and are due to use of cyanide in the milling process for 2 years for the period 1986 to 1988 (Montana Tunnels 2007). Almost all cyanide use in the milling process was discontinued in 1988.

Table 3.7-6 provides a summary of water quality for the M-Pit lake after mining at the equilibrium elevation 5,625 feet, and a comparison of the anticipated lake water quality to DEQ-7 surface water quality standards and the SMCL.

Based on the analysis above, the predicted pit lake water quality would meet DEQ-7 surface water quality standards. The concentration of manganese would exceed the SMCL; however, the M-Pit lake would not be a public water supply, and no outflow from the pit to surface water is anticipated to occur.

TABLE 3.7-6 PROPOSED ACTION SUMMARY OF M-PIT LAKE WATER QUALITY[1]		
Parameter	**Predicted M-Pit Lake Water Quality at Elevation 5,625**	**DEQ-7 Surface Water Standard, or SMCL**
pH	7.5	6.5-8.5*
Calcium	50.67	-
Magnesium	18.6	-
Sodium	9.7	-
Potassium	13.89	-
Sulfate	95.99	250*
Chloride (mg/l)	3.28	-
Fluoride	0.21	4
Nitrate+Nitrite	0.27	10 HH
Cyanide, total	0.00071	0.0052 AC
Arsenic	0.004	0.01 HH
Cadmium	0.00015	0.00052 AC
Copper	0.006	0.0197 AC
Iron	0.18	0.3*
Lead	0.002	0.0097 AC
Manganese	0.145	0.05*
Silver	0.0016	0.018 AA
Zinc	0.013	0. 2516 AC

Notes:
[1] Calculated for the time at which the pit reaches equilibrium at elevation 5,625.
All concentrations are in milligrams per liter, except pH (standard pH units).
The lowest applicable DEQ-7 standard, or SMCL is shown.
- = No DEQ-7 numerical standard or SMCL is available.
* = SMCL
AA = DEQ-7 acute aquatic life standard based on 240 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 240 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
SMCL = Secondary maximum contaminant level
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

Pen Yan Creek
For Alternative 2, there could be a temporary increase in soil erosion and associated load in TSS to Pen Yan Creek during activities related to channel realignment, even if best management practices were utilized. The potential increase in TSS cannot be quantified and depends on the effectiveness of best management practices used. The impact would persist until revegetation of the area was complete. The temporary increase in TSS during the construction period would be an adverse and short-term impact.

Spring Creek
Similar to Alternative 1, the concentrations of sulfate and manganese in Spring Creek would likely remain at 2007 levels, or possibly continue to increase during active mining. After the 5-year closure period, all seepage from the tailings storage facility would be routed to a percolation pond and to groundwater. Seepage would then migrate towards Spring Creek. The concentrations of sulfate, manganese, and iron in Spring Creek would likely temporarily increase in response to the additional flow and load; and then later decrease, as discussed below.

As the tailings continue to consolidate, the seepage rate would decrease and the flow of seepage through the percolation pond would decrease. It is anticipated that the concentrations of sulfate and some metals (manganese, iron) in surface water would also decrease sometime after the tailings consolidate. The future concentrations of sulfate and these metals in Spring Creek can not be quantified, but any increases in the concentration of sulfate or these metals would be temporary (decades). The increase in the concentration of sulfate or these metals would be an adverse, long-term impact.

3.7.3.3 Alternative 3 – Agency Modified Alternative

Environmental consequences related to water quantity and water quality for Alternative 3 are discussed for each of the three drainages in the mine permit area. Environmental consequences for Alternative 3 are similar to environmental consequences for Alternative 2, except as noted in the following sections.

Water Quantity

Clancy Creek
An open-flow channel would be constructed around the M-Pit that would resemble the present Clancy Creek channel (**Figure 2.4-2**). The goal would be to create a stable stream channel that would convey up to the 1 in 20 year return period 24 hour storm event. For Alternative 3, all flow in Clancy Creek less than the design flow would contribute to streamflow. The design would incorporate an overflow structure so that any flows greater than the design flow would be diverted into the mine pit.

Alternative 3 would result in greater long-term flow availability in Clancy Creek (estimated annualized flow of 100 gpm [0.22 cfs]) compared to Alternative 2. Alternative 3 would mitigate the potential adverse long-term impacts to flow identified for Alternative 2.

Pen Yan Creek

The environmental consequences for water quantity under Alternative 3 are similar to the environmental consequences discussed for Alternative 2.

Spring Creek

The environmental consequences for water quantity under Alternative 3 are similar to the environmental consequences discussed for Alternative 2.

Water Quality

Clancy Creek

For Alternative 3, Clancy Creek would not be diverted into the mine pit after mining. Compared to Alternative 2, less water would be available for dilution in the pit lake. The concentrations of most constituents in the pit lake after mining for Alternative 3 would be slightly higher (average 14 percent increase) relative to Alternative 2. **Table 3.7-7** provides a summary for the anticipated pit lake water quality after mining for Alternative 3.

Based on the above analysis, the predicted M-Pit lake water quality would meet DEQ-7 surface water quality standards prior to reaching equilibrium. The concentration of manganese would exceed the SMCL; however, the pit lake would not be a public water supply.

For Alternative 3, Montana Tunnels would collect operational geochemical data and conduct testing on material from the layback required to construct the proposed Clancy Creek channel. These data would help to assess and correct potential water quality issues related to acid rock drainage and the potential for metals mobility.

Pen Yan Creek

The environmental consequences for water quality under Alternative 3 are similar to the environmental consequences discussed for Alternative 2.

TABLE 3.7-7 AGENCY MODIFIED ALTERNATIVE SUMMARY OF M-PIT LAKE WATER QUALITY[1]		
Parameter	**Predicted M-Pit Lake Water Quality at Elevation 5,625**	**DEQ-7 Surface Water Standard, or SMCL**
pH	7.5	6.5-8.5*
Calcium	58.64	-
Magnesium	22.91	-
Sodium	11.30	-
Potassium	17.42	-
Sulfate	112.28	250*
Chloride (mg/l)	4.09	-
Fluoride	0.28	4
Nitrate+Nitrite	0.33	10 HH
Cyanide, total	0.00081	0.0052 AC
Arsenic	0.005	0.01 HH
Cadmium	0.00016	0.00052 AC
Copper	0.0064	0.0197 AC
Iron	0.24	0.3*
Lead	0.0022	0.0097 AC
Manganese	0.151	0.05*
Silver	0.0021	0.018 AA
Zinc	0.012	0. 2516 AC

Notes:
[1] Calculated for the time at which the pit reaches equilibrium at elevation 5,625.
All concentrations are in milligrams per liter, except pH (standard pH units).
The lowest applicable DEQ-7 standard, or SMCL is shown.
- = No DEQ-7 numerical standard or SMCL is available.
* = SMCL
AA = DEQ-7 acute aquatic life standard based on 240 mg/L of hardness, as appropriate
AC = DEQ-7 chronic aquatic life standard based on 240 mg/L of hardness, as appropriate
HH = DEQ-7 surface water standard for human health
SMCL = Secondary maximum contaminant level
Shaded Cell = Concentration exceeds one or more DEQ-7 standards, or the SMCL

Spring Creek

For Alternative 3, Montana Tunnels would conduct an operational verification program to monitor tailings storage facility seepage quality and pit lake water quality during the 5-year closure period to verify estimates of seepage and pit lake water quality provided in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Water quality samples from the combined drains and pit lake would be collected using the laboratory analytical list provided in **Table 3.6-3** and post-mining pit lake elevations provided in **Table 2.2-3**. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The models would be calibrated using operational data. The calibrated models would be re-run and if necessary, pit water or tailings storage facility seepage would be managed or treated, as appropriate.

At the end of the 5-year closure period Montana Tunnels would breach the south pond liner and bury the south pond only if pond water quality meets DEQ-7 standards. If the operational verification program indicated tailings storage facility seepage was worse than predicted in this EIS, the pond liner would not be breached and tailings storage facility seepage would continue to be pumped into the pit or treated, if necessary. Additionally, the recovery well system would be operated to prevent migration of contaminants in groundwater.

3.8 Wetlands

The impacts to wetlands resources from permitting the Montana Tunnels Mine were discussed in the 1986 final EIS under hydrology on page IV-4. This section discusses the wetland resources within the Montana Tunnels Mine study area. Wetlands are lands transitional between terrestrial and aquatic systems and are defined as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, fens, marshes, bogs, and similar areas (U.S. Corps of Engineers 1987).

3.8.1 Analysis Methods

The study area boundaries, sources of information, and methods of analysis for the wetland resources are summarized below.

Analysis Area

The proposed expansion of the Montana Tunnels M-Pit involves disturbance within the Clancy Creek and Pen Yan Creek catchments. There are no existing wetlands associated with Pen Yan Creek, but the drainage was evaluated for a potential wetlands mitigation site. The study area for the inventory of existing wetlands was the expansion area. The study area for potential wetlands mitigation areas included the current and proposed expanded permit area and other possible sites above and below the Montana Tunnels Mine site in the Clancy Creek and Spring Creek drainages.

Information Sources

WESTECH (Montana Tunnels 2007) completed a Wetlands Inventory Baseline Report to determine the presence of wetlands in August 2003 and July 2004 following methods described in the 1987 Wetland Delineation Manual (Environmental Laboratory 1987). The Corps of Engineers conducted a field verification of the proposed expansion area on June 21, 2005. Wetlands determined to be jurisdictional by the Corps of Engineers are regulated pursuant to Sections 404 and 401 of the federal Clean Water Act.

Methods of Analysis

The types, locations, characteristics, and sizes of wetlands were evaluated and compared for each alternative. The potential to successfully create wetlands within the same drainages that provide similar wetland functions to the wetlands that would be lost because of the M-Pit Mine Expansion was also analyzed. Wetlands mitigation

methods and ratio (area of created wetlands to area of destroyed wetlands) were also compared.

3.8.2 Affected Environment

Wetlands provide habitat to plants and animals, protect the quality of surface water by impeding the erosive forces of moving water and trapping sediment and associated pollutants, assist the purification of surface water and groundwater resources, maintain base flow to surface waters through the gradual release of stored floodwaters and groundwater, and provide a natural means of flood control through the absorption and storage of water during high-runoff periods. The existing wetlands within the Montana Tunnels Mine site that would be lost due to the M-Pit Mine Expansion were described and delineated, and the results were provided in the Wetlands Inventory Baseline Report presented by WESTECH (Montana Tunnels 2007).

Clancy Creek wetlands that would be lost are primarily palustrine scrub-shrub (PSS) and palustrine forest (PFO) with small areas of palustrine emergent (PEM) wetlands based on the classification of Cowardin and others (1979). The 1- to 4-foot-wide Clancy Creek channel is incised 1 to 2 feet deep except for a short section where it is has a 4- to 6-foot incised channel. Water is 1 to 6 inches deep (in August) over a generally gravel-lined channel. In the segment of Clancy Creek proposed to be captured by the M-Pit Mine Expansion, the channel is classified as riverine, upper perennial with a gravelly unconsolidated bottom (R3UB1). Below the mine expansion area, Clancy Creek loses flow and becomes intermittent in dry years.

Drummond willow and Booth willow dominate the overstory of the scrub-shrub wetland type. Understory species vary with moisture regime: wettest sites contain beaked sedge, bluejoint reedgrass, and redtop, while dryer sites contain more Kentucky bluegrass and common timothy.

Two palustrine forested types occur along Clancy Creek. The quaking aspen type is present adjacent to the existing mine pit and is dominated by quaking aspen and thinleaf alder. Redtop and Kentucky bluegrass are common understory species. Upstream of the mine pit, the valley narrows and conifers are the prevalent overstory species. Engelmann spruce and Douglas-fir dominate a mixed understory of shrubs, grasses, and forbs. Prominent understory species include red raspberry, thinleaf alder, Bebb’s willow, redtop, bluejoint reedgrass, and common horsetail.

The palustrine emergent type has marginal wetland characteristics and is dominated by herbaceous species, including Kentucky bluegrass, common timothy, Baltic rush, common yarrow, and Nebraska sedge.

Wetland functions and values for Clancy Creek were evaluated using the Montana Wetland Assessment Method (Berglund 1999). Attachment A to the Wetlands Mitigation Plan prepared by WESTECH provides the results of the wetland functions and values assessment (Montana Tunnels 2007). Clancy Creek wetlands rated high for general fish/aquatic habitat, flood attenuation, production export/food chain support, and groundwater discharge/recharge. Using a four category ranking system (I through IV, with I being highest), Clancy Creek wetlands ranked a Category II.

3.8.3 Environmental Consequences

3.8.3.1 Alternative 1 – No Action Alternative (L-Pit)

Wetlands were not evaluated in the 1986 final EIS because no wetland resources were expected to be impacted by the proposed project. Mining over the last 20 years, which would continue as part of the L-Pit under Alternative 1, has had indirect impacts to Clancy Creek wetlands by decreasing Clancy Creek surface water flows. A small volume of water (estimated at 10 to 90 gpm in the 1986 final EIS for Montana Tunnels, DSL 1986) would continue to be lost due to seepage from Clancy Creek alluvium to the L-Pit. It is not known if the seepage lost in this reach of Clancy Creek would help recharge a lower reach of Clancy Creek or would be lost to groundwater that flows into the pit.

The Clancy Creek seepage water was believed to be creating hydrostatic pressure and pit highwall instability in the northwest highwall of the pit near Clancy Creek. Montana Tunnels reduced the pit highwall angle near Clancy Creek and installed a series of horizontal drain wells below the Clancy Creek alluvium in late 1997and then began a substantial dewatering program in 1998 (Montana Tunnels, Revision 98001, 1998). The combined effects of slope reduction and hydrostatic depressurizing have increased the pit highwall strength in this area (Montana Tunnels, 2007). Dewatering activities may have resulted in additional impacts to downgradient Clancy Creek wetlands, but the effects have not been identified.

Under Alternative 1, Montana Tunnels would continue to appropriate an estimated 50 to 250 gpm of flow from Clancy Creek at a point of diversion downstream of Kady Gulch from September 15 to May 15 each year. Montana Tunnels also has another year-round water right on Clancy Creek upstream of the mine pit that is not currently utilized (see surface water hydrology section in Chapter 3). The reduction in Clancy Creek streamflow during active mining would be considered an adverse and short-term impact.

After mining ceases, Montana Tunnels would no longer appropriate and divert surface water from Clancy Creek for makeup water needs at the mine. The 50 to 250 gpm of flow that is appropriated at a point of diversion near the confluence with Kady Gulch

would be available to augment existing instream flows in Clancy Creek and help support existing downstream wetlands, assuming the water rights are not used for another purpose. The impact to Clancy Creek wetlands would be considered a beneficial and long-term impact.

Mining and reclamation planned under the L-Pit Plan would not directly fill or dewater wetlands within Clancy Creek or other tributaries to Spring Creek.

3.8.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

For Alternative 2, approximately 1,800 feet of Clancy Creek channel and associated wetlands in the vicinity of the M-Pit would be excavated and removed during expansion of the mine pit (**Figure 2.3-2**). The flow regime in Clancy Creek would be altered, and the stream channel would be rerouted around the northwest side of the mine in a combined pipe and open-flow channel system. The preliminary design for the diverted channel is provided in **Appendix A** of this EIS.

Table 3.8-1 provides the wetland types and acres that would be directly and indirectly impacted by the mine expansion into the Clancy Creek drainage under the M-Pit Mine Expansion plan. Mining would impact 2.633 acres of wetlands. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation. The total wetland disturbance is 4.77 acres. The total proposed mitigation is 5.13 acres. Wetlands disturbance, mitigation acreage and mitigation ratios are provided in **Table 3.8-2**.

TABLE 3.8-1
WETLAND TYPE AND ACRES IMPACT BY M-PIT MINE EXPANSION

Wetland Type (Cowardin Class)	Clancy Creek Wetland Impacts		
	Direct (acres)	Indirect (acres)	Total (acres)
PEMA	0.216	0	0.216
PSSA/PEMA	0.037	0.05	0.087
PSSC	1.152	0.106	1.258
PSSC/PFOC	0.354	0	0.354
PFOC	0.348	0.37	0.718
TOTALS	**2.107**	**0.526**	**2.633**

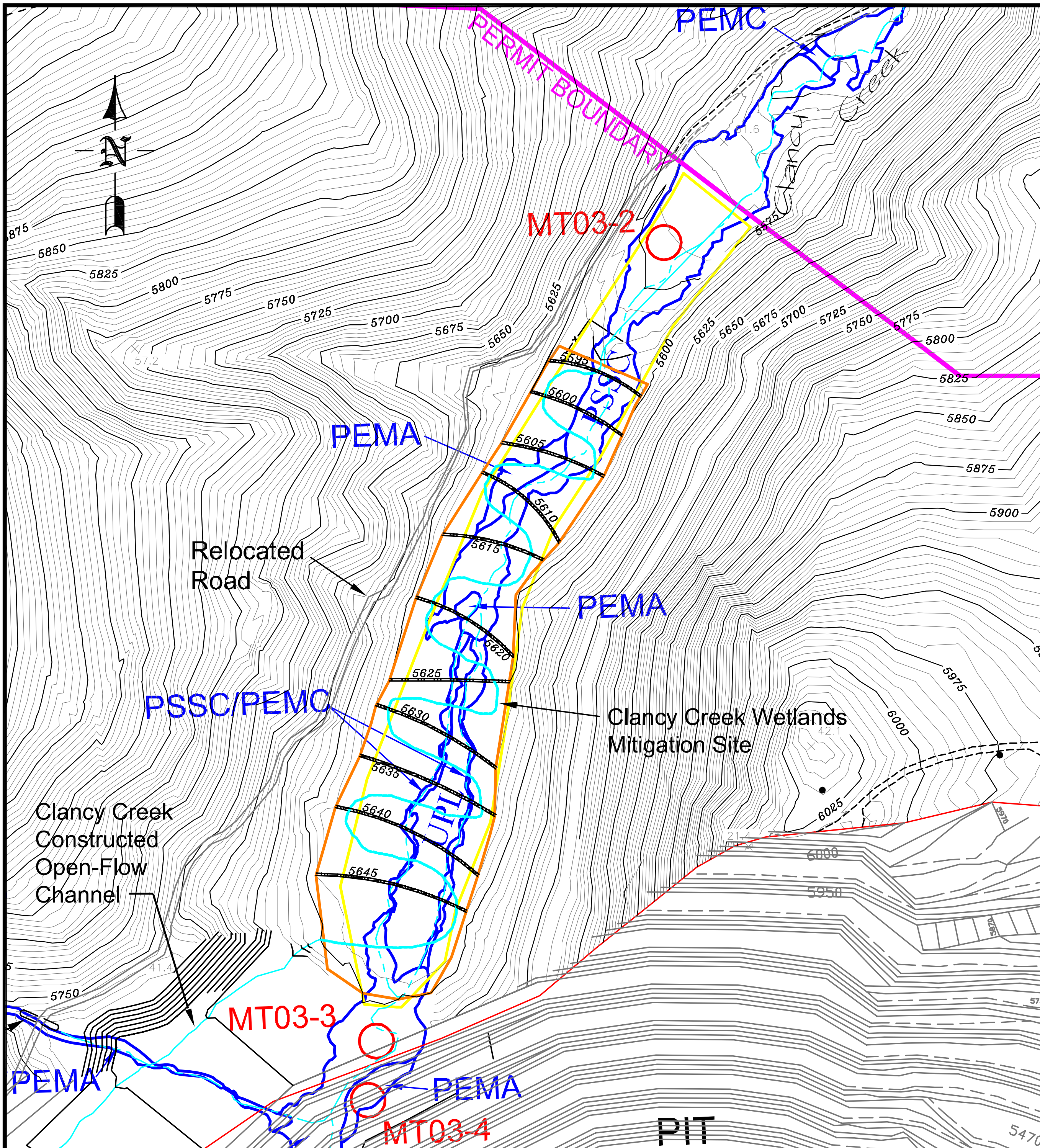
Notes:
PEMA Palustrine emergent (temporarily flooded)
PSSA Palustrine scrub-shrub (temporarily flooded)
PSSC Palustrine scrub-shrub (seasonally flooded)
PFOC Palustrine forested (seasonally flooded)

TABLE 3.8-2 WETLANDS DISTURBANCE, MITIGATION ACREAGE AND MITIGATION RATIOS				
Wetland Vegetation Type	**Wetland Disturbance Area (acres)**	**Percent**	**Proposed Mitigation Ratio**	**Proposed Mitigation Area (acres)**
Mine Pit Expansion Area				
Emergent	0.22	9	1:1	0.22
Scrub-shrub	1.70	64	1:1	1.70
Forest	0.72	27	1.5:1	1.08
Total	2.64	100	1.14:1	3.00
Mitigation Area				
Emergent	0.50	23	1:1	0.50
Scrub-shrub	1.63	77	1:1	1.63
Total	2.13	100	1:1	2.13
TOTAL	**4.77**			**5.13**

Conceptual Wetlands Mitigation Plan

A proposed Clancy Creek wetlands mitigation site has been identified in the Clancy Creek drainage immediately below the mine site **(Figure 3.8-1)**. This site was designed to address either Alternative 2 – Proposed Action Alternative, where Clancy Creek is diverted into a pipe and open-flow channel, or Alternative 3 - the Agency Modified Alternative, where Clancy Creek is restored by construction of an open-flow channel in an alternate location. The Clancy Creek mitigation site contains 6.54 acres of upland vegetation and 2.13 acres of wetlands for a total size of 8.67 acres. The mitigation site has sufficient area to create a minimum of 3.00 new acres of wetlands. The 2.13 acres of wetlands would be temporarily impacted by construction of the additional wetlands. The proposed total mitigation would be 5.13 acres.

The proposed wetlands mitigation plan would create 3.0 acres of new wetlands to replace the 2.633 acres of wetlands impacted by the M-Pit Mine Expansion for an average replacement ratio of 1.14 to 1. Details of the wetlands mitigation plan are provided in **Appendix A** of this EIS.



WETLAND LEGEND

- PERMIT BOUNDARY
- WETLAND PLOT
- EXISTING WETLAND BOUNDARY
- PROPOSED WETLAND MITIGATION SITE
- ORIGINAL WETLAND MITIGATION SITE (2005)

WETLAND CLASSIFICATION	
POW	PALUSTRINE OPEN WATER
PEM	PALUSTRINE EMERGENT
PFO	PALUSTRINE FORESTED
PSS	PALUSTRINE SCRUB-SHRUB
UPL	UPLAND
R3UB1	RIVERINE UPPER PERENNIAL UNCONSOLIDATED BOTTOM COBBLE/GRAVEL

WATER REGIME	
A	TEMPORARILY FLOODED
C	SEASONALLY FLOODED
D	SEASONALLY FLOODED/WELL DRAINED
F	SEMIPERMANENTLY FLOODED
H	PERMANENT
Y	SATURATED/SEMIPERMANENT/SEASONAL

SPECIAL MODIFIERS	
b	BEAVER
d	PARTIALLY DRAINED/DITCHED
h	DIKED/IMPOUNDED
s	SPOIL

NOTE: Surface Configuration for Alternative 3 - Agency Modified Alternative is shown.

FIGURE 3.8-1
Wetlands Mitigation Site For Both Action Alternatives

Montana Tunnels Project

3.8.3.3 Alternative 3 – Agency Modified Alternative

The wetlands resources impacted by mining under Alternative 3 would be similar to impacts described under Alternative 2. A same total of 2.633 acres of wetlands would be impacted along Clancy Creek. The same wetlands mitigation area would be constructed in the Clancy Creek valley downstream of the M-Pit under both Alternative 2 and Alternative 3.

During active mining, Clancy Creek would be diverted around the expanded M-Pit in a constructed open-flow channel. The difference between Alternatives 2 and 3 for wetlands is that Alternative 3 provides potential for some additional wetlands to naturally reestablish along the full length of the reconstructed Clancy Creek channel during operations; no wetlands would establish along the portion of Clancy Creek contained in a pipe under Alternative 2.

The conceptual design for the channel was prepared by Knight Piésold Ltd. and is discussed in Section 3.7 and **Appendix A** (Montana Tunnels 2007). If the M-Pit Mine Expansion is approved, the slope above the Clancy Creek diversion would be laid back (regraded) to a 2h:1v slope angle with a natural dendritic drainage pattern constructed in the slope. An approximate 300-foot-wide graded alluvial bench would be constructed for the reestablishment of a Clancy Creek channel. The bed and bank channel would have some meanders. The channel would be approximately 50 feet from the toe of the proposed layback slope to prevent erosion of the 2h:1v slope toe and a minimum of 200 feet from the crest of the mine pit. The 200-foot buffer between the M-Pit rim and active channel would provide some security for future channel meandering outside the designed reconstructed channel. The channel would convey up to the 1 in 20 year return period 24 hour storm event around the M-Pit to the wetlands mitigation site downstream.

The Alternative 3 proposed Clancy Creek wetlands mitigation is the same as Alternative 2. The wetlands mitigation site has a large enough area to create a minimum of 3.0 additional wetland acres. The 8.67 acre site currently supports 6.54 acres of upland and 2.13 acres of wetlands. The 2.13 acres of existing wetlands may be temporarily impacted by construction of the additional wetlands. The new wetlands would create a 1.14 to 1 ratio of wetlands replaced for wetlands lost.

3.9 Wildlife

The wildlife resources affected environment was discussed in the 1986 final EIS on page III-28. The impacts to wildlife resources from permitting the Montana Tunnels Mine were discussed in the 1986 final EIS on page IV-23. The 1985 EIS did not discuss potential impacts to wildlife from metals or other chemicals or reagents. Potential additive biological effects are discussed under cumulative impacts in Chapter 4.

Regulatory Framework

Numerous laws, policies, and management direction apply to wildlife resources and their habitat.

1. The **Endangered Species Act** (ESA) of 1973, as amended, requires federal agencies to undertake programs conserving threatened and endangered species and prohibits them from carrying out or authorizing any action that may jeopardize a listed species or its critical habitat. It mandates that the effects of management activities and land uses be evaluated in a biological assessment for listed species. If a project may affect a federally listed species or critical habitat, Section 7 consultation must be initiated with the U.S. Fish and Wildlife Service (USFWS).

2. The **Bald and Golden Eagle Protection Act of 1940** (16 USC 668-668d) prohibits all commercial activities and some non-commercial activities involving bald or golden eagles, including their feathers or parts, and makes it illegal "…without being permitted to do so as provided in this subchapter, (to) take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles."

3. The **Migratory Bird Treaty Act** of 1918 (16 U.S.C. 703-712) implements various treaties and conventions between the U.S., Canada, Mexico, and Japan for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is illegal. Executive Order 13186 (January 10, 2001) requires federal agencies to ensure that environmental analyses of federal actions evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern.

4. **Bureau of Land Management (BLM) Manual.** BLM policy is to provide sensitive species with the same level of protection as is provided for candidate species (BLM Manual 6840.06 C). BLM sensitive species typically "are species that occur on BLM-administered lands for which BLM has the capability to significantly affect the conservation status of the species through management" (USDI BLM 2001).

3.9.1 Analysis Methods

Analysis Area

Various wildlife species exhibit differing levels of site fidelity and movement. The effects analysis area is the current L-Pit Plan operating permit area and the proposed M-Pit Mine Expansion expanded permit area for Alternatives 2 and 3. The cumulative effects analysis area is the premine baseline wildlife study area (Farmer and others 1985, Montana Tunnels 2007).

Information Sources

Baseline wildlife studies were conducted prior to development of the Montana Tunnels Mine in 1984 and 1985 (Farmer and others 1985). The baseline studies included the proposed mine area plus a buffer around areas potentially affected by mine development. This 16-square-mile study area included all of the area proposed for M-Pit Mine Expansion. Because the past studies included the proposed M-Pit Mine Expansion area, qualitative reconnaissance-level surveys were used to augment previously collected data for the proposed mine expansion (Montana Tunnels 2007). Field reconnaissance surveys were used to evaluate existing habitat conditions and document wildlife occurrence in the project area. Comparisons of existing conditions with the impacts predicted in the 1986 final EIS were made to determine whether such impacts occurred (Montana Tunnels 2007). In most instances, the field reconnaissance was insufficient to identify adequately most predicted impacts. Wildlife species were not monitored during mine development.

Additional information sources were queried to document wildlife occurrence and use of the project area and vicinity. Known occurrences of species of special concern (threatened, endangered, and candidate species, and BLM sensitive species), and important habitats were obtained from the following sources:

- Montana Natural Heritage Program – Element occurrence records and point observation database. Element occurrence records are credible locations of populations or habitat necessary to the maintenance of populations of species of special concern. Element occurrence data do not represent species absence. Point observation data contain verified and unverified animal records.

- Montana Fish, Wildlife and Parks – Information Management furbearer database, GIS maps of seasonal ungulate ranges, and personal communications with area wildlife biologists, state furbearer coordinator, statewide wolf coordinator.
- Helena National Forest, Helena District wildlife files, GIS layers of modeled potential habitat for Canada lynx in Lynx Analysis Unit DI-06 and other USFS sensitive and management indicator species, and personal communications with forest and district wildlife biologists. An implicit assumption associated with maps of potential habitat is that the habitat models adequately represent habitat potential for each species. Documents describing modeling methods and data assumptions are contained in the EIS project file.

In addition to these information sources, published and unpublished literature and relevant management plans were reviewed to assess potential effects of the Proposed Action on wildlife and compliance with current regulations. The level of analysis was dependent upon a number of factors, including existing condition, risks to resources, and information necessary for an informed decision.

Methods of Analysis

Biodiversity is a term that describes the variety of life forms, the ecological role they perform, and the genetic diversity they contain (Wilcox 1984, page 640). For wildlife, this includes the variety of wildlife species occurring at Montana Tunnels and adjacent areas, and the habitats that are required to sustain populations of those species. For migratory species, such as neotropical migrant birds, Montana Tunnels and vicinity may provide seasonal breeding or migratory habitat, while winter habitat occurs elsewhere. The aspects of biodiversity discussed in this section involve wildlife species likely to occur in the vicinity of Montana Tunnels and their associated habitats.

It is unrealistic to evaluate all wildlife species that may occur within the defined analysis areas. The scope of analysis for this project focuses on a subset of species, including special status species that represent other species that use similar habitats. Such species include federally listed threatened, endangered, and candidate species; BLM designated sensitive species; and Montana big game species. Only those federally listed and BLM sensitive species or their habitats that have the potential to be impacted by the Proposed Action are addressed in this EIS (see **Table 3.9-1**).

TABLE 3.9-1 SPECIAL STATUS WILDLIFE SPECIES (USFWS THREATENED, ENDANGERED, AND CANDIDATE SPECIES; BLM SENSITIVE SPECIES)		
Common/Scientific Name	**Status**	**Habitat**
Threatened, Endangered, and Candidate Species		
Bald eagle (*Haliaeetus leucocephalus*) - Threatened	Not resident in project area, but may migrate through the area. Further analysis conducted. Recommended for delisting on June 28, 2007, effective August 8, 2007. Automatically will be placed on BLM sensitive species list.	Nesting and perching trees near water with primary prey species (fish and waterfowl) present.
Canada lynx (*Felis lynx*) - Threatened	Not documented in project area, preferred habitat not present, but could move through the area. Further analysis conducted.	Boreal forest habitat with large woody debris and suitable habitat for primary prey (snowshoe hare) present (usually above 4,000 feet elevation).
Gray wolf (*Canis lupus*) - Endangered	Not documented in project area, but habitat is present. Further analysis conducted.	Forest and shrubland habitats with adequate prey base of big game animals present.
Grizzly bear (*Ursus arctos horribilus*) - Threatened	Not documented in project area; outside of recovery zone and occupied habitat. Further analysis conducted.	Remote forest habitats with low road density and minimal human disturbance.
Black-footed ferret (*Mustela nigripes*) - Endangered	Not documented in project area, habitat not present. Listed as Endangered in Jefferson County, but unlikely to be found in the project area. No further analysis conducted.	Prairie habitats with large prairie dog colonies. Prairie dog colonies are found on flat, open grasslands and shrub/grasslands with low, relatively sparse vegetation.
BLM Sensitive Bird Species		
Black-backed woodpecker (*Picoides arcticus*)	Not documented in project area, preferred habitat not present, but could occur in the project area. Further analysis conducted .	Foraging and nesting habitats in conifer forests that have insect infestations associated with fire and disease.
Brewer's sparrow *(Spizella breweri)*	Not documented in project area, marginal habitat present. Further analysis conducted.	Shortgrass prairie with scattered or abundant sagebrush or other arid shrub habitats.
Flammulated owl (*Otus flammeolus*)	May be present in project area, habitat present. Further analysis conducted.	Nests primarily in mature and old-growth ponderosa pine and Douglas-fir forests.
Golden eagle *(Aquila chrysaetos)*	Present in project area, habitat present. Further analysis conducted.	Prefers open habitats and nests on cliffs or large trees.
Great gray owl (*Strix nebulosa*)	Not documented in project area, habitat present. Further analysis conducted.	Nests in snags, cavities, and stick nests in mature conifer forest, often near meadows and forest openings.

TABLE 3.9-1 (Cont.)
SPECIAL STATUS WILDLIFE SPECIES
(USFWS THREATENED, ENDANGERED AND CANDIDATE SPECIES; BLM SENSITIVE SPECIES)

Common/Scientific Name	Status	Habitat
Loggerhead shrike (*Lanius ludovicianus*)	Present in project area, habitat present. Further analysis conducted.	Open shrub and grassland habitats.
Northern goshawk (*Accipiter gentilis*)	Present in project area, habitat present. Further analysis conducted.	Nests in mature to old-growth conifer and aspen forest.
Three-toed woodpecker (*Picoides tridactylus*)	Present in project area, habitat present. Further analysis conducted.	Breeds and forages in conifer forests with high incidence of insect infestation from fire, disease, or wind throw
Trumpeter swan (*Cygnus buccinator*)	Migratory through project area. Further analysis conducted.	Nests in emergent vegetation at edge of lakes and ponds.
BLM Sensitive Mammal Species		
Fringed myotis *(Myotis thysanodes)*	Not documented in project area, but habitat present. Further analysis conducted.	Variety of habitats from low to mid-elevation grassland, woodland, and desert regions, up to and including spruce-fir forests.
Long-eared myotis *(Myotis evotis)*	Not documented in project area, but habitat is present. Further analysis conducted.	Often associated with forested stands containing old-growth characteristics, but found in habitats characterized by shrubland and juniper.
Long-legged myotis *(Myotis volans)*	Not documented in project area, but habitat is present. Further analysis conducted.	Primarily montane coniferous forest and riparian habitat.
Townsend's big-eared bat (*Plecotis townsendii*)	Not documented in project area, but habitat present. Further analysis conducted.	Roosts and hibernates in caves and mines and forages over open areas with wetlands and riparian communities.
Wolverine (*Gulo gulo luscus*)	Not documented in project area, preferred habitat not present, but could move through the area. Further analysis conducted.	Forages in remote areas of boreal forests and dens in high-elevation cirques.
BLM Sensitive Amphibians		
Western toad *(Bufo boreas)*	Not documented in project area, but habitat present. Further analysis conducted.	Uses a variety of habitats including low elevation beaver ponds, reservoirs, streams, marshes, lake shores, potholes, wet meadows, and marshes, to high elevation ponds, fens, and tarns at or near treeline.

Notes: Additional species and reasons for "no further analysis" are provided in the Biological Evaluation (in the project file) and the Biological Assessment.

The Montana Natural Heritage Program (MTNHP 2006) identifies animals of concern that are native Montana animals considered to be "at risk" due to declining population trends, threats to their habitats, and/or restricted distribution. All but three BLM sensitive species (i.e., golden eagle, long-eared myotis, and long-legged myotis) are listed as animals of concern by the Montana Natural Heritage Program. BLM sensitive species and federally listed species rely on habitats that would be preferred by other wildlife species of concern (*e.g.*, grasshopper sparrow, lark bunting, olive-sided flycatcher) that might occur at Montana Tunnels. Effects from project implementation to BLM sensitive wildlife species and listed threatened and endangered species would be similar for Montana wildlife species of concern that have similar habitat and life history requirements.

3.9.2 Affected Environment

Wildlife Habitat

The Montana Tunnels L-Pit operating permit area and proposed M-Pit Mine Expansion area (**Figure 3.3-1**) contains a diversity of topographic and edaphic features, and a variable precipitation pattern (Farmer and others 1984, DSL 1985, Montana Tunnels 2007). These variable factors yield a variety of vegetation types that in turn serve as habitat for a diverse array of wildlife species.

Existing vegetation types at Montana Tunnels and adjacent areas are characteristic of the mountains and foothills east of the Continental Divide (DSL 1985, Montana Tunnels 2007). DSL (1985) listed 17 wildlife habitat types, which included small amounts of agricultural cropland (<1 percent) and hayfield (<1 percent) and miscellaneous disturbed land (<2 percent). Most of the premining wildlife study area consisted of native grassland and Douglas-fir/grassland types. North and east aspects are dominated by coniferous forests, while south and west slopes are occupied by more open habitats (DSL 1985).

Within the proposed M-Pit Mine Expansion area, a 2004 WESTECH Wildlife Report (Montana Tunnels 2007) identified six upland and four wetland wildlife habitat types (**Table 3.9-2**). Montana Tunnels provided estimated acres of wildlife habitat types in the M-Pit Plan but did not distinguish between upland and wetland types (Montana Tunnels Mining, Inc. 2007). In the listing of wildlife habitats within the premining wildlife study area, specific wetland types were not differentiated from upland types, except for the willow type (DSL 1985, Montana Tunnels 2007). The M-Pit Mine Expansion area is dominated by Douglas-fir-forested habitat types (Montana Tunnels 2007, LeMieux 2006).

TABLE 3.9-2 WILDLIFE HABITAT TYPES PROPOSED MONTANA TUNNELS M-PIT MINE EXPANSION AREA		
Landform	**Vegetation type[a]**	**Wildlife habitat type[b]**
Upland	Douglas-fir/rough fescue Douglas-fir/pinegrass	101. Douglas-fir/grassland
	Douglas-fir/common snowberry	115. Douglas-fir/deciduous shrub
	Quaking aspen	170. Aspen
	Rough fescue/bluebunch wheatgrass Rough fescue/Idaho fescue Idaho fescue/bluebunch wheatgrass	300. Grassland
	Introduced grasses	520. Hay
	Reclamation	Not Mapped
Wetland	Drummond willow Booth willow	172. Willow bottom
	Quaking aspen/shrub	170. Aspen
	Engelmann spruce/Douglas-fir/shrub	115. Douglas-fir/deciduous shrub
	Grassland	520. Hay

Notes:

[a] Montana Tunnels 2007 (2004 WESTECH Wildlife Report)

[b] Farmer and others 1985

Wildlife Species

WESTECH (Montana Tunnels 2007) identified 367 wildlife species that may be found within a one-degree-latitude by one-degree-longitude area (2,048,000 acres) that included the Montana Tunnels Mine. Such a large area includes many species that are unlikely to occur in the vicinity of the mine due to lack of appropriate habitat (*e.g.*, mountain goat, pica) within the relatively small size of the total proposed permit area (2,382 acres).

During baseline wildlife studies in 1984 and 1985 WESTECH identified 111 wildlife species (25 mammals and 86 birds) (Montana Tunnels 2007**).** The reconnaissance conducted in 2003 and 2004 added one amphibian (spotted frog), one reptile (rubber boa), and two birds (snow goose and house sparrow). Open water habitat was generally not available prior to L-Pit development. Since mine development, mine personnel have observed a variety of waterfowl using the tailings impoundment, particularly during fall migration (Montana Tunnels 2007). Some employees reported seeing ducklings on the impoundment, suggesting some birds may nest near the impoundment. Mine personnel have also observed tadpoles and small frogs in the

tailings impoundment, most likely spotted frogs (*Rana luteiventris*). This information suggests that spotted frogs may breed and undergo metamorphosis in the impoundment.

Special Status Species

Species with special status include federally listed threatened and endangered species and BLM designated sensitive species. Threatened and endangered species and BLM sensitive wildlife species that may occur in the M-Pit Mine Expansion area are listed in **Table 3.9-1**.

USFWS Threatened, Endangered and Candidate Species

Gray Wolf – Endangered

The gray wolf is currently listed as endangered in Lewis & Clark County and Jefferson County, west of Interstate-15, which includes Montana Tunnels. Wolves west of I-15 are fully protected under the Endangered Species Act. East of I-15 the gray wolf is considered an experimental non-essential population (USDI 2006).

While there are no known wolf packs in the vicinity of the Montana Tunnels Mine, transient individuals may pass through the area. Montana Fish, Wildlife and Parks (FWP) reported the gray wolf was recorded in the Occidental Plateau area, just west of Montana Tunnels during or prior to 2002 (Montana Tunnels 2007). The nearest known wolf pack is the Spotted Dog pack, south of Avon, Montana, approximately 25 miles northwest of the project area (USDI and others 2006).

Grizzly Bear – Threatened

The grizzly bear was listed as threatened throughout its range in the lower 48 states on July 28, 1975. The Grizzly Bear Recovery Plan was approved in 1982, updated in 1990 and 1992, and revised is 1993 (USFWS 1993). Seven grizzly bear ecosystems were identified in which recovery is to be accomplished, the nearest of which is the Northern Continental Divide Ecosystem Recovery Zone (NCDE). The NCDE is, approximately 43 miles northwest of Montana Tunnels. In recent years, grizzly bears have been expanding their range outside of the recovery zone. The mapped distribution of grizzly bears south of the NCDE is approximately 25 miles north of the Montana Tunnels Mine, in Lewis and Clark County and Powell County (USDA Forest Service and others 2002). Transient grizzly bears could move through the vicinity of the mine. According to WESTECH (Montana Tunnels 2007), FWP reported that a grizzly bear was observed 10 miles west of the mine, in the Basin Creek area. This area is also in the vicinity of the Continental Divide, which is identified as a potentially important movement corridor for wildlife, including grizzly bears (Joslin 2005). Linkage areas facilitating the movement of individuals between populations are important to recovery of the grizzly bear (USFWS 1993). However, there is no evidence of grizzly bear denning or

reproduction occurring in Jefferson County. USFWS does not consider Jefferson County as an area where one would reasonably expect grizzly bear to occur (USFWS 2007).

Canada Lynx – Threatened

The Clancy Creek portion of the proposed Montana Tunnels M-Pit Mine Expansion is considered to be within Canada lynx range (Montana Tunnels 2007). The Montana Tunnels existing permit area is at the lower limit of the reported distribution of lynx habitat east of the Continental Divide (approximately 6,000 feet elevation). The habitat types within the expansion area are not considered preferred habitat for lynx, although lower elevation coniferous and shrub-steppe habitat may provide linkage to primary habitats.

The Helena National Forest modeled and mapped potential lynx habitat within Lynx Analysis Unit (LAU) DI-06, one-half mile west of Montana Tunnels (USFS 2005). There is little mapped potential lynx habitat on the Helena National Forest in the vicinity of Montana Tunnels. Potential lynx habitat in the southern portion of LAU DI-06 is patchy and probably low quality habitat.

There are records of lynx north and west of Montana Tunnels. A lynx was killed in 2003 on U.S. Highway 12, approximately 15 miles northwest of the project area (Joslin 2005). There is a 1981 harvest record 13 miles northwest of the project area, and recent verified lynx tracks along a winter track survey route between upper Basin Creek Drainage and Rimini, approximately 12 miles northwest of Montana Tunnels (Giddings 2005).

There are no known resident lynx in the vicinity of Montana Tunnels, and there are no recent or historic accounts of denning or reproduction near Montana Tunnels. Lynx are highly mobile and capable of dispersing long distances across habitats generally considered unsuitable (Tumlison 1987, Kohler and Aubry 1994, USDI 2003).

BLM Sensitive Wildlife Species

Bald Eagle – State Species of Concern

On June 28, 2007 the bald eagle was removed from the list of threatened and endangered species (USFWS 2007). The final rule became effective on August 8, 2007. To ensure that eagles continue to thrive, the USFWS will work with FWP to monitor eagles for at least 5 years. The bald eagle is a state species of concern and will be added to the BLM sensitive species list.

Nesting and wintering eagles can be found along the Missouri River, at least 23 miles east of the Montana Tunnels Mine. Although bald eagles have been seen flying over the

Project area, habitat for bald eagles is not present (Montana Tunnels 2007). There is a potential that they could forage on waterfowl on the impoundment during operations.

Black-backed Woodpecker

Black-backed woodpecker is a montane forest species and is often found in lower elevation Douglas-fir forests (Hart and others 1998, MTNHP 2005). They forage in areas with dead or decaying trees. In Montana, they are strongly associated with post-fire habitat. Large fires in 2000 provided large blocks of habitat on the Helena National Forest and an area approximately 3 miles south of Montana Tunnels. Because of the absence of preferred habitat in and adjacent to the mine permit area and expansion area, black-backed woodpeckers are expected to be uncommon or rare in the live-forested habitat. Black-backed woodpecker was not documented in the vicinity of Montana Tunnels and preferred habitat is not found within the expansion area (Montana Tunnels 2007).

Brewer's Sparrow

Brewer's sparrow is widespread throughout Montana (Lenard and others 2003). It is a dominant species in sagebrush habitats found in a wide range of elevations (Hart and others 1998). Nests are in low shrubs, usually sagebrush (Dobkin 1994). Numbers have declined in Montana and Idaho, possibly as a result of sagebrush control (Dobkin 1994). Brewer's sparrow has not been documented in the vicinity of Montana Tunnels, although habitat occurs in the L-Pit Plan operating permit area and the proposed M-Pit Mine Expansion area.

Flammulated Owl

Flammulated owl is a small owl that feeds almost exclusively on invertebrates (*e.g.*, insects, spiders, centipedes) and is a neotropical migrant (Dobkin 1994). In the central and northern Rocky Mountains, flammulated owls are associated with mature to old-growth ponderosa pine and Douglas-fir forests, and stands tend to be relatively open (Hart and others 1998). WESTECH suggested that it was possible that a western screech-owl tentatively identified during premining baseline studies in 1984 and 1985 may have been a flammulated owl (Montana Tunnels 2007). WESTECH indicated that preferred habitat of this species occurs in the proposed M-Pit Mine Expansion area; however, no estimates of the amount of potential habitat exist for the expansion area and existing permit area (Montana Tunnels 2007). A known occurrence of flammulated owls was recorded by MTNHP 10 miles north of the Montana Tunnels Mine (Montana Tunnels 2007).

Golden Eagle

Golden eagles currently breed and winter widely throughout Montana (Lenard and others 2003). A pair of golden eagles has been nesting along the mine access road for many years. The nest is in a Douglas-fir tree up hill from the access road,

approximately 150 feet from the road. This nest was active during 2002 through 2004; nest success has not been monitored (Montana Tunnels 2007).

Great Gray Owl

The great gray owl is the largest North American owl. In Montana, great gray owl preferred habitat tends to be associated with meadows or mixed deciduous/coniferous forest. Great gray owls have not been documented in the vicinity of the project. The M-Pit Mine Expansion area is in marginal great gray owl habitat.

Loggerhead Shrike

Loggerhead shrikes use open country from prairies to montane meadows with scattered trees and shrubs. While loggerhead shrike has been documented in the vicinity of the Montana Tunnels Mine, the M-Pit Mine Expansion area does not contain preferred habitat (Montana Tunnels 2007).

Northern Goshawk

The northern goshawk is typically associated with mature to old-growth forest habitats. They often nest on gentle north-facing slopes. Nest stands tend to have a high degree of canopy closure, allowing goshawks to maneuver in and underneath the canopy while foraging (Hart and others 1998). Northern goshawk was documented in the vicinity of Montana Tunnels, and preferred habitat occurs within the proposed expansion area (Montana Tunnels 2007).

Three-toed Woodpecker

Three-toed woodpeckers occur in mountain forests in western Montana (Hart and others 1998). They are associated with subalpine fir and Engelmann spruce in higher elevations and with lodgepole pine forests or in mixed-conifer forests with a lodgepole pine component at lower elevations (Montana Partners in Flight 2000). They respond positively to landscape disturbances including fire and insect epidemics. A three-toed woodpecker was documented in the vicinity of Montana Tunnels; however, preferred habitat is not found within the proposed expansion area (Montana Tunnels 2007).

Trumpeter Swan

Most breeding swans in Montana are found in the greater Yellowstone area, with a smaller breeding population along the Rocky Mountain Front in Lewis and Clark County (MTNHP 2005). There has also been an ongoing effort for several years to reestablish a breeding population in the Blackfoot River catchment on the west side of the Continental Divide. There is no trumpeter swan habitat in the vicinity of Montana Tunnels. Mine personnel have observed swans, Canada geese, and various species of ducks using the tailings pond, primarily during fall migration (Schaefer 2005). Which swan species have used the tailings pond is unknown. Trumpeter swans could migrate through this area during spring and fall migration.

Fringed Myotis

Western Montana is on the northeastern limit of the distribution of fringed myotis (Foresman 2001). Fringed myotis occurs in a variety of low to mid-elevation habitats, including desert habitats, grassland, woodland, up to and including spruce-fir habitats (Foresman 2001). Common roost sites include caves, rock crevices, abandoned mines, and buildings (Adams 2003; Foresman 2001). This species was not documented in the vicinity of Montana Tunnels, but potential habitat occurs in the proposed M-Pit Mine Expansion area (Montana Tunnels 2007). There is a record of fringed myotis 11 miles southeast of the mine.

Long-eared Myotis

Long-eared myotis are distributed from western Canada south to Baja California, Mexico (van Zyll de Jong 1985, pg. 98) including all of Montana (Foresman 2001). Long-eared myotis forage over a variety of habitats, including shortgrass prairie, dry juniper-sagebrush habitats, and ponderosa pine and Douglas-fir forests (Foresman 2001). Roost sites include caves, mines, and buildings. This species was not documented in the vicinity of the Montana Tunnels Mine, but potential habitat occurs in the proposed expansion area (Montana Tunnels 2007).

Long-legged Myotis

Long-legged myotis range from southern Alaska into northern Mexico, including all of Montana (Adams 2003, pg 199). They roost in trees (under thick bark), buildings, caves, and abandoned mine tunnels; while hibernating in more protected sites such as caves (Foresman 2001). This species is known to occur in Jefferson County (Foresman 2001). Long-legged myotis was not documented in the vicinity of the Montana Tunnels Mine, but potential habitat occurs in the proposed M-Pit Mine Expansion area (Montana Tunnels 2007).

Townsend's Big-eared Bat

Townsend's big-eared bats are found in a variety of habitats including mesic coniferous and deciduous forests, as well as dry coniferous and scrub habitats (Kuntz and Martin 1982, MTNHP 2005). These bats typically use caves and abandoned mines for maternity roosts and hibernacula, but use of buildings has been reported (MTNHP 2005). Townsend's big-eared bats forage near foliage of trees and shrubs (Kuntz and Martin 1982, MTNHP 2005). This species has been documented in Jefferson County (Foresman 2001). This species was not documented in the vicinity of the Montana Tunnels Mine, but potential habitat occurs in the proposed M-Pit Mine Expansion area (Montana Tunnels 2007). Cliffs and abandoned mines in the vicinity of the mine could provide habitat for Townsend's big-eared bat.

Wolverine
In the northern Rocky Mountains, wolverines primarily inhabit coniferous forest (Foresman 2001, Hornocker and Hash 1981). Wolverines were not documented in the vicinity of Montana Tunnels, and preferred habitat does not occur in the proposed M-Pit Mine Expansion area. Wolverines occur in Jefferson County, are capable of extensive movements, and likely could pass through the mine area. The USFS has modeled and mapped potential wolverine natal denning habitat. Potential denning habitat occurs on the Beaverhead-Deerlodge National Forest, 4 or more miles west of Montana Tunnels. FWP trap harvest records indicate that two wolverines were harvested in 1995 and 1996 approximately 5 miles west of Montana Tunnels (Giddings 2005)

Western Toad
Adult western toads are primarily terrestrial and occur in a variety of habitats from valley bottoms to high elevations in western Montana (MTNHP 2005). Western toads have not been observed at Montana Tunnels or in the proposed M-Pit Mine Expansion area. Western toads are known to occur in Jefferson County (Werner and others 2004), and suitable habitat occurs within the proposed M-Pit Mine Expansion area (Montana Tunnels 2007). Western toads have been documented north of the project area in the Lump Gulch drainage, near Park Lake, and the North Fork of Quartz Creek (approximately 4 miles northwest of Montana Tunnels) (MTNHP 2005 and 2005a). It is likely that they may occur in or near the project area.

Big Game

Wildlife habitat in the vicinity of Montana Tunnels supports a variety of big game. Big game species documented in the vicinity of Montana Tunnels and the proposed expansion area include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), moose (*Alces alces*), black bear (*Ursus americanus*), and mountain lion (*Puma concolor).*

Elk
Elk are present in the vicinity of Montana Tunnels' proposed M-Pit Mine Expansion area (DSL 1985, Montana Tunnels 2007). Recent mapping of elk seasonal ranges indicates that the Montana Tunnels operating permit area and proposed M-Pit Mine Expansion area are in combined summer and winter habitat. The nearest mapped elk crucial winter range (FWP 1999) is located approximately 4.5 miles east of the Montana Tunnels Mine, on the west slope of the Elkhorn Mountains (**Figure 3.9-1**). Crucial winter range is defined as "That part of the winter range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten" (FWP 1999).

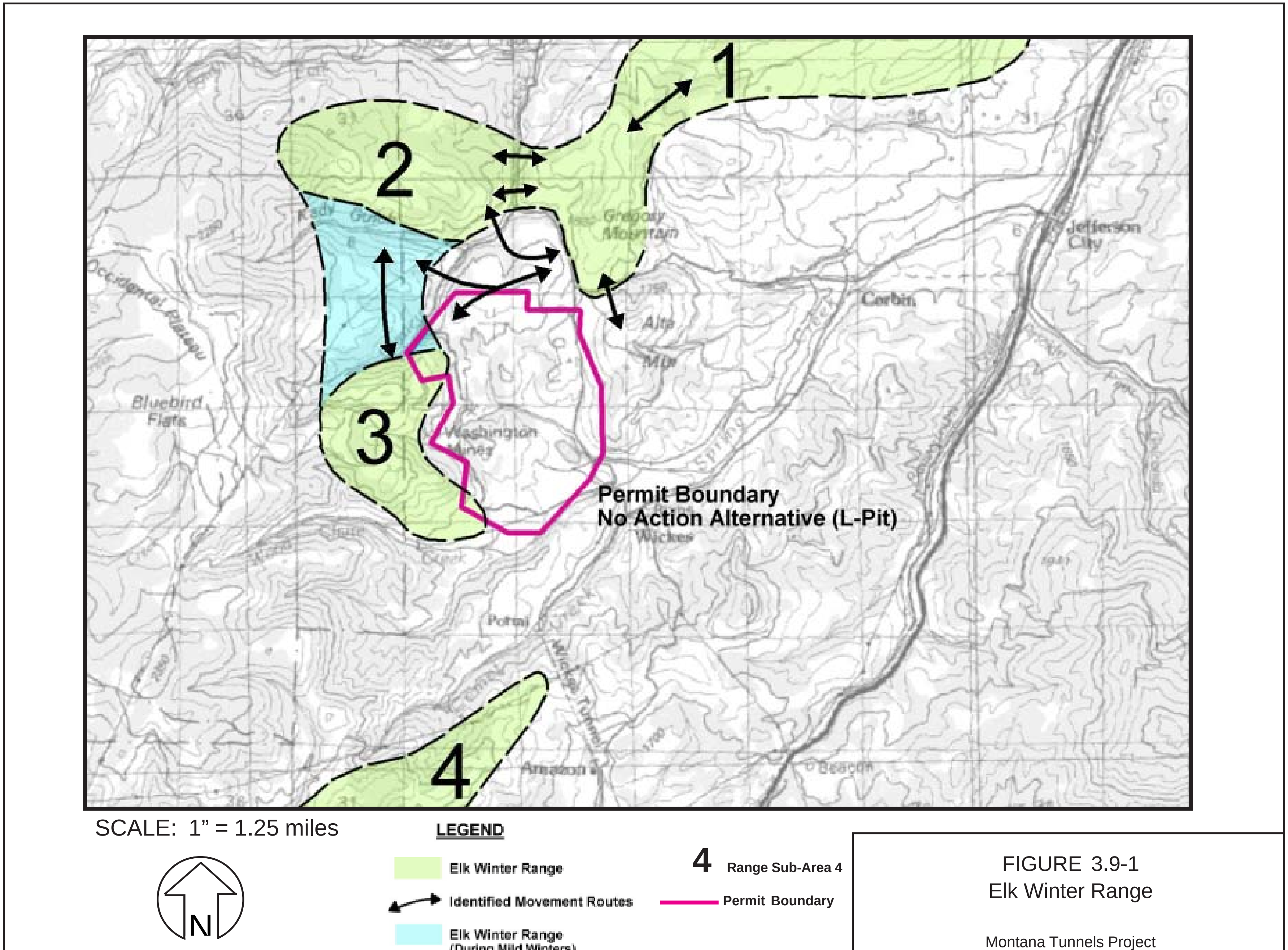


FIGURE 3.9-1
Elk Winter Range

Montana Tunnels Project

WESTECH indicated that the 1984 and 1985 baseline wildlife studies demonstrated that elk were uncommon in the vicinity of Montana Tunnels during spring through fall (Montana Tunnels 2007). During those seasons, most elk sightings were in the mountains west of the mine area and in the Gregory Mountain-Alta Mountain area. The mine vicinity provided winter range habitat, and the number of elk counted increased during winter. An estimated 25 square miles of elk winter range occurred in the wildlife baseline aerial study area (Farmer and others 1985). DSL (1985) indicated that most winter elk sightings came from four concentration areas.

1. Gregory Mountain area
2. Kady/Morgan Gulch area
3. Washington Hill area
4. Spring Creek/Boulder River area

During winter, elk primarily used grassland and Douglas-fir/grass habitats on southerly aspects with gentle to moderate slopes. Baseline observations indicated that elk moved between winter concentration areas, including through the area that would become the Montana Tunnels Mine.

Based on comparisons between 1984 and 1985 baseline studies and recent FWP winter elk observations, WESTECH suggested two conclusions relative to elk distribution in the vicinity of Montana Tunnels Mine over time (Montana Tunnels 2007).

- The distribution of elk during the winter may have changed in hunting district 335 either as a result of increased elk numbers or due to displacement of some elk away from human developments in the district. Both studies mapped generally similar winter concentration areas.
- Both studies demonstrated a gap in elk winter concentration within the Montana Tunnels operating permit area. Elk movement through the operating permit area was precluded since mine development. FWP data were collected after mine development (Joslin 2003, 2004).

Several factors confound comparisons between baseline elk observation and current winter distributions. Farmer and others (1985) monitored elk distribution for only one winter and primarily in the vicinity of the proposed mine, rather than the entire hunting district. Elk numbers have changed since the pre-mine condition. There has been considerable residential development within portions of the hunting district that is unrelated to mine development that may have affected elk numbers and distribution. The effects of prolonged drought on the elk herd in the hunting district have not been quantified.

WESTECH reported that some elk have habituated to the presence of the mine and mining activity (Montana Tunnels 2007). Evidence of elk use of reclaimed areas was observed, which suggested an eastward extension of the Washington Hill winter concentration area. Also, winter elk pellet distribution suggested a southern extension of the Gregory Mountain winter concentration area. In addition, Montana Tunnels personnel observed elk and other wildlife in and near the mine operating permit area. Since hunting and other forms of wildlife harassment are prohibited within the mine permit boundary, elk use of the mine area is expected.

Elk numbers are currently below established population objectives for hunting district 335 (Montana Tunnels 2007). Factors potentially contributing to lower elk numbers include suburban sprawl, overgrazing by livestock, disturbance from off-road vehicle use (particularly snowmobile use), widespread vehicle access on public and private land, and mining (Joslin 2003, 2004).

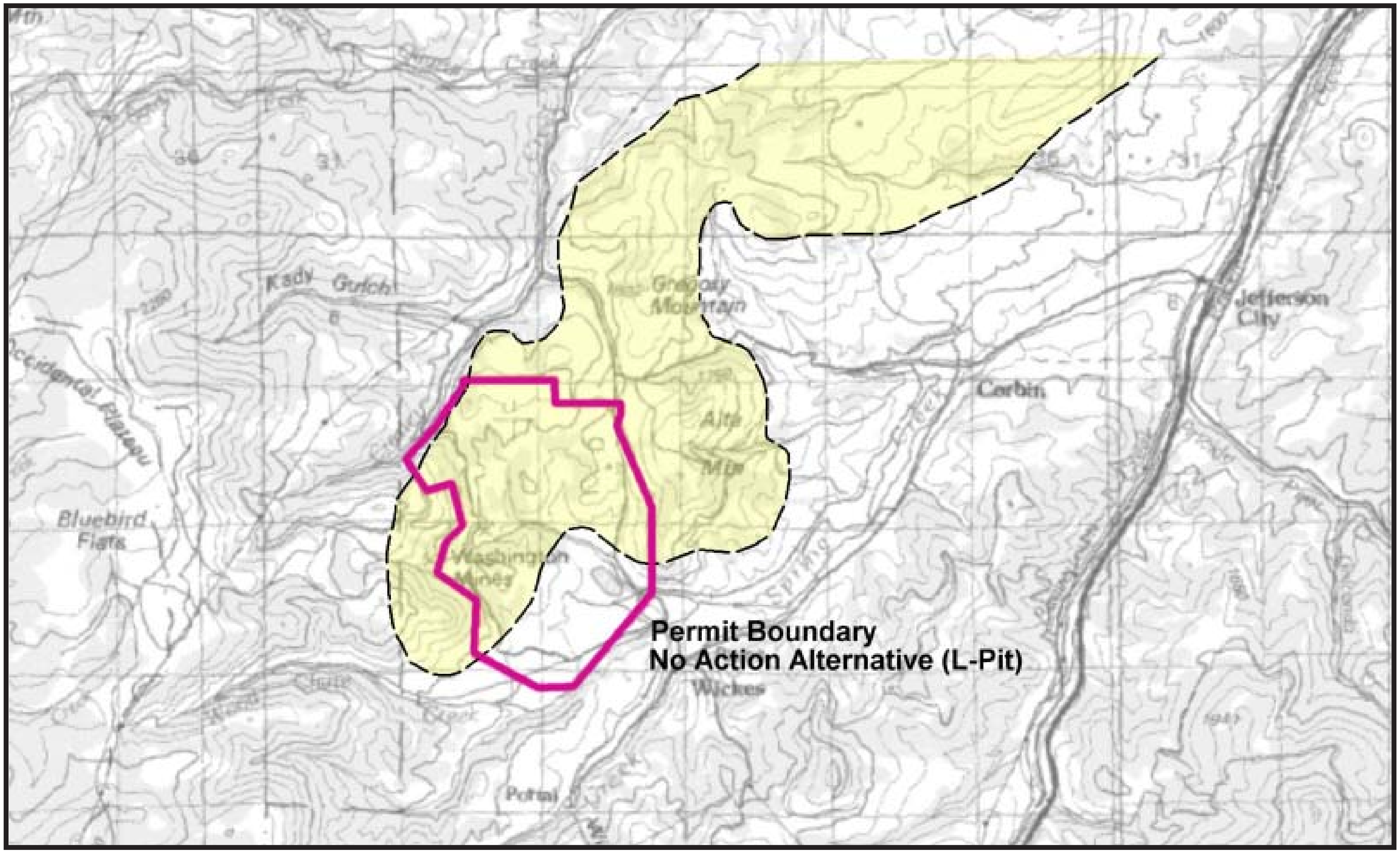
Mule Deer

Mule deer were the most commonly observed big game animal during baseline studies at the Montana Tunnels Mine, and their habitat is present within the proposed M-Pit Mine Expansion area (Montana Tunnels 2007). Reported mule deer numbers during baseline studies and current counts by FWP are highly variable. DSL (1985) mapped mule deer winter range, which includes Gregory Mountain and areas to the northeast of Gregory Mountain, Alta Mountain and areas east of Alta Mountain that include the mine operating permit area (**Figure 3.9-2**).

Mule deer continue to use the mine operating permit area. WESTECH found that mule deer distribution and habitat use do not seem to have undergone any substantial change since the baseline studies were completed (Montana Tunnels 2007). While mule deer numbers fluctuate seasonally and annually, mule deer are present in the vicinity of the mine year round.

Moose

Moose have been documented in the vicinity of the Montana Tunnels Mine, and preferred habitat is found within the proposed M-Pit Mine Expansion area. Evidence of moose was observed in the willow bottom habitats along Clancy Creek and Kady Gulch during premining baseline wildlife studies and during the 2003 to 2004 reconnaissance. FWP has reported that there is a small but gradually increasing moose population in hunting district 335. Creek bottom habitats are important winter range for this species.



SCALE: 1" = 1.25 miles

LEGEND

N

Permit Boundary

Mule Deer Winter Range

SOURCE: Westech Inc.

FIGURE 3.9-2
Mule Deer Winter Range

Montana Tunnels Project

Black Bear

Black bears were observed in the vicinity of Montana Tunnels during baseline studies (1984-1985) and during field reconnaissance in 2004. Habitat for black bears occurs within the proposed M-Pit Mine Expansion area.

Mountain Lion

Evidence of mountain lions in the vicinity of Montana Tunnels was observed during premining baseline studies (Farmer and others 1985). Habitat for mountain lions occurs in the proposed M-Pit Mine Expansion area.

3.9.3 Environmental Consequences

3.9.3.1 Alternative 1 – No Action Alternative (L-Pit)

Under the No Action Alternative, Montana Tunnels would continue to operate under the existing L-Pit Plan until 2009. Impacts to wildlife from past mine development and current mine operation would continue until mining ceases, disturbed sites are reclaimed, and human activities in the area are reduced. Effects resulting from altered habitats, including reclaimed sites, would persist.

The 1986 final EIS predicted a variety of adverse impacts to wildlife from mining activity and associated disturbance (DSL 1986). Impacts may include:

- Direct loss of habitat.
- Reduction in forage productivity and/or availability.
- Disturbance and displacement of wildlife.
- Habituation of some wildlife to human activity.
- Physiological stress.
- Habitat fragmentation and isolation.
- Increases in competitive and predatory organisms.
- Secondary effects created by work force (*e.g.*, poaching, vehicle collisions).

Wildlife species, including big game, were not monitored during mine development. Consequently, determining the impacts to some species, particularly population level effects, is not feasible. FWP did initiate winter surveys of elk and other big game in 1989. WESTECH attempted to evaluate the occurrence of potential impacts predicted by DSL (1985) (Montana Tunnels 2007).

DSL (1985, page xi) summarized potential impacts to wildlife from mine development as:

> "Mining would destroy 932 acres of wildlife habitat. Mining activity and loss of summer range would force mule deer into surrounding habitats. Elk that use a winter-concentration area adjacent to the mine would move west to avoid mining activity. Mule deer and elk may eventually become accustomed to mining activity and begin using habitats near the permit area. Other wildlife species would undergo a similar displacement and habituation process…the excavation of a 162-acre mine pit would significantly reduce wildlife habitat in the permit area. The quality of wildlife cover in reclaimed lands would be lowered due to reduced densities of shrubs and conifers. Mule deer, however, may benefit from the increased acreage of foraging habitat. Small increases in poaching, wildlife harassment and road kills are anticipated."

Amendments and revisions to the original Operating Permit 00113 from 1986-2007 increased the projected disturbance area from an estimated disturbance area of 932 acres to 1,176 acres (Montana Tunnels 2007). DSL (1986) noted that all wildlife habitat types that would be disturbed through mining were abundant in the mine vicinity, and no unique or limited habitats would be lost.

Big Game

While there was loss of elk winter range, a comparatively small amount of available winter range has been disturbed by mining. According to WESTECH current winter distributions of elk are similar to those identified by DSL (1985) (Montana Tunnels 2007). Wintering elk are generally absent from the mine area (Joslin 2003). Wintering elk would likely avoid the mine until reclamation is complete and human activity is diminished. A large portion of the mine area is mule deer winter range. While mule deer may avoid the mine, winter distributions of mule deer do not appear to have changed appreciably (Montana Tunnels 2007).

WESTECH noted that displacement of resident animals likely occurred, but that effect is difficult to measure (Montana Tunnels 2007). Some elk and mule deer have habituated to mine-related activity and have been observed in and adjacent to the mine. While there is documented use of a reclaimed waste rock storage area by deer and elk, most disturbed habitat would not be reclaimed until mining ceases and would likely be avoided by wildlife.

Mine development has interfered with movement of elk between the Gregory Mountain and Washington Hill concentration areas (*i.e.*, displacement). Elk apparently adjusted

their travel routes, since elk continue to use the Gregory Mountain/Alta Mountain concentrations areas (Montana Tunnels 2007).

Moose habitat has not been impacted by current mine development. It is unknown if moose movements have been altered due to mining activity. Black bear habitat has been impacted, and bears likely have been displaced into adjacent areas. Mountain lions prey primarily on deer, but also prey on elk. Displacement of primary prey species of mountain lions would likely result in the displacement of lions. Large predators, like mountain lion, occur at low densities. Effects of mine development likely affected few individuals.

Other mammals have not been monitored, but the impacts predicted by DSL (1985) likely occurred. Less mobile species (*e.g.*, rodents) may have been killed during mine development, while mobile species were likely displaced. Mammals with limited mobility would also be at risk for mortality resulting from mine traffic. Small mammals would repopulate reclaimed areas.

Birds

Nesting and foraging habitat for birds were reduced by surface disturbance associated with mine development. Grassland habitats were most prevalent within the original permit boundary (about 50 percent), while forested and shrub habitats accounted for 33 percent and 8.5 percent of the area, respectively. Grassland/shrubland species would have been impacted most by development activity. Birds are mobile and readily flee disturbance, and likely would quickly recolonize revegetated areas. WESTECH observed courtship displays of western meadowlarks and vesper sparrows on reclaimed waste rock storage areas in June 2003 (Montana Tunnels 2007).

Raptor species using the mine area would have lost a small amount of foraging habitat, and tree removal would have reduced nesting and perching habitat. WESTECH noted suspected red-tailed hawk and great horned owl nesting territories adjacent to the existing L-Pit Plan mine permit area and a golden eagle nest along the mine access road (Montana Tunnels 2007). They concluded that these occurrences suggested that raptors were not substantially affected by mine development and activity.

Montana Tunnels is located in the Clancy Mining District, which has a substantial history of mining activity and there are numerous abandoned mines in this district and adjacent mining districts. A recent water quality restoration report (DEQ 2006b) for the Lake Helena catchment area identified as a water quality problem high metal (*e.g.*, arsenic, cadmium and lead) concentrations in several water bodies in and adjacent to the Montana Tunnels wildlife study area. High metal concentrates were attributed to mining and mine drainage, particularly from abandoned mines, and erosion of sediments from other sources. Montana Tunnels tailings pond water contains low

levels of lead and cadmium, which may be hazardous to wildlife over time. The average value for dissolved lead in the tailings pond for 2002 through 2005 was <0.003 mg/L, and dissolved cadmium 0.0004 mg/L (**Table 3.6-10**). The predicted value for dissolved lead in the L-Pit Lake (elevation 5,610 feet) is 0.0036 mg/L, and dissolved cadmium 0.0008 mg/L (**Table 3.6-5**). These concentrations, except for cadmium, are all below DEQ-7 chronic aquatic life standards (DEQ 2006a). There are no standards set for wildlife species.

Waterfowl have been observed using the tailings storage facility as a resting site during spring and fall migration. In addition, there were reported observations of ducklings on the pond. Waterfowl may be exposed to low levels of heavy metals such as cadmium and lead contained in the tailings solution.

Trace metals, such as lead and cadmium, may concentrate in organisms. While lead does not magnify up the food chain, cadmium does have potential to bioaccumulate (Eisler 1985, 1988). Eisler (1985) indicates that freshwater aquatic organisms accumulate cadmium from water containing cadmium concentrations not previously considered hazardous to public health or to many species of aquatic life. Studies have indicated that cadmium can bioaccumulate through terrestrial food webs and can affect health, behavior, and population status of ptarmigan (Pederson and Saether 1999, Larison and others 2000). Pathways for potential exposure of wildlife to cadmium exist at Montana Tunnels and elsewhere in the Clancy Creek watershed. However, there have been no studies of cadmium exposure in wildlife at Montana Tunnels or the Clancy Creek watershed. If tissue concentrations are sufficiently high, waterfowl may be at risk of mortality or sublethal effects. If trace metal levels are not necessarily toxic to individual waterfowl, metals (*e.g.*, cadmium) may reach harmful concentrations in predators through bioaccumulation. Lead and cadmium ingested by birds using the tailings pond would likely add to the existing body burdens of those metals in the individual birds. Since lead does not appear to biomagnify, there may be limited potential for accumulated lead to affect predators. Cadmium can biomagnify and raptors feeding on waterfowl exposed to cadmium could potentially be exposed to harmful cadmium concentrations. The potential for metals, primarily cadmium, from the tailings storage facility to concentrate and impact raptors is unknown since studies have not been conducted to evaluate the exposure potential.

Bald Eagle –BLM Sensitive Species and State Species of Concern

On June 28, 2007 the bald eagle was removed from the list of threatened and endangered species (USFWS 2007). The final rule became effective August 8, 2007. To ensure that eagles continue to thrive, the USFWS will work with FWP to monitor eagles for at least 5 years. Potential impacts to bald eagle nesting and foraging habitat and adherence to Montana Bald Eagle Management Plan nest territory guidelines are used to evaluate impacts to bald eagles. The analysis area is the existing permit area.

Implementation of the No Action Alternative may affect, but is not likely to adversely affect bald eagles or their habitat. The distance from the project area to an active nest and primary use areas is greater than 2.5 miles. Although transient bald eagles might occasionally fly over the operating permit area, habitat for bald eagles is not present. Availability of carrion for foraging would be unaffected, but bald eagles are unlikely to forage in the permit area due to the lack of foraging opportunities in the mine area and the level of human activity. It is possible for bald eagles to forage on waterfowl that may have been exposed to metals (*e.g.*, cadmium), from the tailings pond. If metal concentrations are sufficiently high, eagles could suffer secondary adverse impacts due to exposure to metals. The potential for indirect and cumulative impacts to eagles from secondary exposure to metals from Montana Tunnels is unknown, since studies have not been conducted to evaluate the exposure potential.

Amphibians and Reptiles

Pre-mine baseline wildlife studies did not document presence of any amphibians or reptiles. Since mine development, spotted frogs have been documented along Clancy Creek (Montana Tunnels 2007) and in the tailings pond (Schaefer 2005). Also, a rubber boa was observed by WESTECH (Montana Tunnels 2007). Due to their relative low mobility, amphibians and reptiles in the mine area may have experienced direct mortality from ground clearing and construction activities during mine development. Amphibians and reptiles are at risk for vehicle-caused mortality along mine access roads and haul roads. In addition, there would have been a loss of habitat associated with mine development.

Amphibians potentially are more susceptible to environmental contaminants because of their complex life cycles and more permeable skin. Almost all amphibians require moisture to complete their life cycle, and most are aquatic in their egg or larval stages. Carey and Bryant (1995) discussed a number of pathways through which amphibians could be impacted by environmental contaminants. Toxicants need not be directly lethal to affect amphibians. Sub-lethal concentrations of some contaminants may increase susceptibility of larvae to disease or increase predation on larvae by impacting swimming ability or by retarding growth rates. In particular, they point out that "endocrine-disrupting toxicants can have effects at tissue levels well below detectable levels," and that "toxicants designated as safe should not be considered to be free of endocrine-disrupting effects until proven otherwise" (Carey and Bryant 1995, pg 16).

It is unknown what impact chemicals and metals in the tailings storage facility may have on amphibians during operations. It is possible that there could be sublethal impacts to developing amphibians. Cadmium and lead may accumulate in aquatic plants and animals (Eisler 1985, 1988). Exposure of amphibians to metals could result in sublethal toxic effects. Exposure of amphibian larvae to cadmium can reduce survival rates (James and others 2005). The potential of pollutants in the tailings storage facility

to bioconcentrate and potential impacts to amphibians have not been measured and studies have not been conducted to evaluate the exposure potential.

Threatened and Endangered Species

Gray Wolf – Endangered

Effects to gray wolves were evaluated by assessing potential project impacts to known den or rendezvous sites, impacts to important wolf prey or their habitat such as big game winter range, and increases in mortality risk to wolves. The effects analysis area for gray wolf is the operating permit area and immediate vicinity.

Alternative 1 may affect, but is not likely to adversely affect the gray wolf or its habitat. Under this alternative current habitat conditions would persist, and existing levels of human activity would continue. There are no known wolf dens or rendezvous sites near the Montana Tunnels Mine. Impacts to elk, primary prey species, have already occurred through mine development. Elk in the area appear to have adjusted to mining activity. While there was some loss of winter range habitat due to mine development and activity, the amount of habitat that has been lost is relatively small.

Elk numbers in 2004 are below FWP population objectives. Factors potentially contributing to lower elk numbers include suburban sprawl, overgrazing by livestock, disturbance from off-road vehicle use (particularly snowmobile use), widespread vehicle access on public and private land, and mining (Joslin 2003, 2004). It is unclear what population-level effects development of the Montana Tunnel Mine may have had. Also, the influence of recent climate patterns on elk numbers is unknown. Cumulative impacts from suburban development (habitat loss and disturbance) and other land management practices, such as livestock overgrazing, may have additive negative effects to elk populations. Reductions in elk numbers potentially may reduce wolf foraging opportunities.

Grizzly Bear – Threatened

Effects to grizzly bear were evaluated by assessing the potential for grizzly bears to occur in the permit area and potential for mine development and activity to affect grizzly bears. The effects analysis area for grizzly bear is the permit area and immediate vicinity.

Alternative 1 would have no effect on grizzly bears or their habitat. USFWS does not identify the grizzly bear as expected to occur in Jefferson County. The NCDE recovery zone is more that 40 miles to the north, and the mapped distribution of bears outside the NCDE recovery zone is approximately 25 miles north of the permit area. There is no documented occurrence of grizzly bear use of the operating permit area or the larger wildlife baseline study area. It is unlikely that grizzly bears would occur in or near the mine area.

Canada Lynx – Threatened
Effects to Canada lynx were evaluated by assessing impacts to lynx habitat. The effects analysis area for Canada lynx is the operating permit area and immediate vicinity.

Alternative 1 may affect, but is not likely to adversely affect Canada lynx or its habitat. Under this alternative current habitat conditions would persist, and existing levels of human activity would continue into 2009.

The Montana Tunnels Mine is at the estimated lower limit of potential lynx habitat (approximately 6,000 ft). Habitat within the operating permit area is not considered preferred habitat for lynx. There are no known or historic records of resident lynx in or adjacent to the project area. Because of the absence of preferred habitat and lack of contiguous potential lynx habitat in the southern portion of LAU DI-06, west and northwest of Montana Tunnels, it is unlikely that lynx would occur near the Montana Tunnels Mine.

Canada lynx may be tolerant of moderate levels of human activity and disturbance (Claar et al. 1999, Roe and others 1999). Lynx are capable of extensive exploratory and dispersal movements. It is possible that transient lynx could move through the area. Mine development and activity could displace transient lynx. Because of the limited potential for lynx to occur near the Montana Tunnels Mine, it is unlikely that mine development and production had measurable impacts on Canada lynx. Recreational activity (*e.g.*, snowmobiling, skiing) within in lynx habitat may disturb lynx.

BLM Sensitive Wildlife Species

Black-backed Woodpecker
Impacts were evaluated based on occurrence of black-backed woodpecker habitat within the project area and potential to impact black-backed woodpecker or their habitat. The effects analysis area is the operating permit area and the cumulative effects analysis area is the baseline wildlife study area.

Under Alternative 1, there would be no changes to potential black-backed woodpecker habitat. Densities of black-backed woodpeckers in the vicinity of the Montana Tunnels Mine are expected to be low because habitat is limited due to the lack of fire or insect mortality. Recent fires (2000) in Jefferson and Lewis and Clark counties created preferred black-backed woodpecker habitat. Because of the absence of preferred habitat within the permit area and baseline wildlife study area, black-backed woodpeckers are expected to be uncommon or rare in the live-forested habitat. Mine development resulted in loss of an estimated 327 acres of forested habitat (LeMieux, P. 2006). This loss of forested habitat would have little effect on the black-backed woodpecker population. It is unlikely that residential development near the Montana Tunnels Mine would measurably diminish black-backed woodpecker habitat. Alternative 1 may

impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for black-backed woodpecker.

Brewer's Sparrow

Impacts were evaluated based on occurrence of Brewer's sparrow habitat within the project area and potential to impact Brewer's sparrow or their habitat. The effects analysis area is the operating permit area, and the cumulative effects analysis area is the baseline wildlife study area.

Under Alternative 1, there would be no changes to potential Brewer's sparrow habitat. Mine development resulted in the loss of grassland and big sagebrush/grassland habitat that might have provided habitat for Brewer's sparrow. Brewer's sparrow has not been documented at the Montana Tunnels Mine (Farmer and others, 1985, Montana Tunnels 2007). The effects of habitat loss resulting from mine development and operation would persist until mining ceases and successful reclamation is accomplished.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for Brewer's sparrow.

Flammulated Owl

Impacts were evaluated based on occurrence of flammulated owl habitat within the mine area and potential to impact flammulated owls or their habitat. The effects analysis area is the operating permit area, and the cumulative effects analysis area is the baseline wildlife study area.

Under Alternative 1, there would be no changes to potential flammulated owl habitat. Mine development resulted in the loss of Douglas-fir and ponderosa pine habitat that may have provided flammulated owl habitat. It is unknown how much of the forested habitat that was lost to mine development consisted of relatively open old growth and mature ponderosa pine and Douglas-fir habitat. While flammulated owl has not been documented at Montana Tunnels, WESTECH suggested that a tentatively identified screech owl during pre-mine baseline studies might have been a flammulated owl (Montana Tunnels 2007). The effects of habitat loss resulting from mine development and operation would persist until mining ceases, reclamation is complete, and forested habitat is replaced. Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for flammulated owl.

Golden Eagle
Impacts were evaluated based on occurrence of golden eagle habitat within the mine area and potential to impact golden eagles or their habitat. The effects analysis area is the operating permit area.

Under the No Action Alternative, there would be no changes to potential golden eagle habitat. Mine development resulted in the direct loss of golden eagle habitat and habitat for prey species. Mine activity may have displaced golden eagles from nesting or foraging adjacent to the L-Pit and other mine facilities. WESTECH noted that an active golden eagle nest is adjacent to the mine access road, suggesting that displacement effects to golden eagles may be minimal (Montana Tunnels 2007).

Residential development within the wildlife baseline study area would likely result in the loss of additional nesting and foraging habitat for golden eagles. This potential loss of habitat would be additive to habitat lost to mine development.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for golden eagle.

Great Gray Owl
Evaluation of impacts was based on occurrence of great gray owl habitat within the project area and potential to impact great gray owls or their habitat. The effects analysis area is the operating permit area.

Although great gray owl has not been documented at the Montana Tunnels Mine, there is potential habitat within the permit area and baseline wildlife study area. Under Alternative 1, there would be no changes to potential great gray owl habitat.

Mine development resulted in the direct loss of potential great gray owl nesting and foraging habitat. Mine activity may have displaced great gray owls nesting or foraging adjacent to the L-Pit and other mine facilities.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for great gray owl.

Loggerhead Shrike
Impacts were evaluated based on occurrence of loggerhead shrike habitat within the Mine area and potential to impact loggerhead shrike or their habitat. The effects analysis area is the operating permit area.

Loggerhead shrike was observed during wildlife baseline studies in the vicinity of Montana Tunnels (Montana Tunnels 2007). Under Alternative 1, there would be no changes to potential loggerhead shrike habitat. Loggerhead shrike would have been displaced during mine development due to the direct loss of open shrub and grassland habitats. Displacement would persist for the life of the mine. Following mine closure and successful reclamation, loggerhead shrike would likely recolonize suitable habitat.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for loggerhead shrike.

Northern Goshawk

Impacts were evaluated based on occurrence of northern goshawk habitat within the mine area and potential to impact northern goshawk or their habitat. The effects analysis area is the operating permit area.

Northern goshawk was observed during wildlife baseline studies in the vicinity of the Montana Tunnels Mine (Farmer and others 1985) and potential habitat occurs within the proposed M-Pit Mine Expansion area (Montana Tunnels 2007). Farmer and others (1985) suggested that nesting habitat was available in the western third of the wildlife study area. Under Alternative 1, there would be no changes to potential goshawk habitat. Mine development likely resulted in the direct loss of some goshawk nesting and foraging habitat. Any goshawks previously inhabiting the mine area would have been displaced.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for northern goshawk.

Three-toed Woodpecker

Impacts were evaluated based on occurrence of three-toed woodpecker habitat within the mine area and potential to impact three-toed woodpecker or their habitat. The effects analysis area is the operating permit area.

Three-toed woodpecker was observed during baseline wildlife studies (Montana Tunnels 2007). They are associated with subalpine fir and Engelmann spruce in higher elevations and with lodgepole pine forests or in mixed-conifer forests with a lodgepole pine component at lower elevations. Suitable habitat occurs within the baseline wildlife study area, but suitable habitat does not occur within the proposed M-Pit Mine Expansion area. Under Alternative 1, there would be no changes to potential three-toed woodpecker habitat. It is unknown how much potential three-toed woodpecker habitat was affected by mine development. Loss of suitable habitat would have displaced resident woodpeckers.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for three-toed woodpecker.

Trumpeter Swan

Impacts were evaluated based on occurrence of trumpeter swan habitat within the mine area and potential to impact trumpeter swans or their habitat. The effects analysis area is the operating permit area.

Trumpeter swan habitat does not exist within the baseline wildlife study area. Mine development created resting habitat in the form of the tailings storage facility. Under Alternative 1, there would be no changes to potential trumpeter swan habitat. Mine personnel reported observation of swans using the tailings storage facility. It is possible that trumpeter swans would use the tailings storage facility during fall and spring migration. It is unlikely that large numbers of swans would use the tailings storage facility, or that swans would spend a long period of time on the facility during migration. Swans using the tailings storage facility could be exposed to low levels of heavy metals or milling reagents as discussed above under waterfowl. The potential for harmful effects to swans and other waterfowl using the pond during operations is unknown. This exposure would occur during operations, but would end after the mine is reclaimed under all alternatives.

Alternative 1 may impact individuals or resting habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for the trumpeter swan.

Fringed Myotis, Long-eared Myotis, Long-legged Myotis, and Townsend's Big-eared Bat

Impacts were evaluated based on occurrence of habitat for BLM sensitive bat species within the mine area and potential to impact BLM sensitive bats or their habitat. The effects analysis area is the operating permit area.

Surveys for bats have not been conducted in the vicinity of the Montana Tunnels Mine. Suitable habitat for a variety of bat species is present, and the mine is within the expected distributions of fringed myotis, long-eared myotis, long-legged myotis, and Townsend's big-eared bat. While all four species may use caves and cliffs as roosts, Townsend's big-eared bats are mostly associated with these structures. The three other species of myotis may roost in trees, buildings, talus slopes, cliffs, and caves. All four BLM sensitive bats are likely to forage over riparian vegetation and wetlands within the operating permit area and baseline wildlife study area. Under Alternative 1, there would be no changes to current habitat conditions for BLM sensitive bats.

Clearing trees during mine development likely removed roosting and foraging habitat for BLM sensitive bat species. Any cliffs or rock outcrops that were removed during mining may have resulted in loss of habitat for bats, including Townsend's big-eared bat. Riparian and wetland habitats are likely the most productive foraging habitat for bats. Wetlands and riparian areas were not impacted by L-Pit mine development. Habitat lost to mining would persist throughout the life of the mine, until forest recolonized reclaimed areas. Any impacted cliffs and rock outcrops would be permanently lost. The upper exposed pit highwall would remain and potentially could provide roosting habitat for a variety of bat species.

Bats would likely use the tailings storage facility as a source of drinking water and may forage on insects over the tailings storage facility. Bats consuming water or insects emerging from the tailings storage facility would be exposed to low levels of metals and chemicals in the tailings water. Bats accumulate metals from the food chain in areas of pollution from industrial sources (Reinhold and others 1999, O'Shea and others 2000). Insects that spend part of their life cycle in the tailings storage facility may contain elevated levels of metals, such as cadmium. Bats often feed on insects that emerge from aquatic environments (*e.g.*, mayflies, stoneflies, dragonflies, mosquitoes, and gnats). The extent to which bats would frequent the tailings pond, resulting in ingestion of metals is unknown.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for fringed myotis, long-eared myotis, long-legged myotis, and Townsend's big-eared bat.

Wolverine

Impacts were evaluated based on occurrence of potential wolverine habitat within the mine area and potential to impact wolverine or their habitat. The effects analysis area is the operating permit area.

Habitat preferred by wolverine does not occur in the Montana Tunnels Mine operating permit area. Potential natal denning habitat occurs approximately 4 or more miles west of Montana Tunnels. Wolverines may be attracted to ungulate winter range in the vicinity of Montana Tunnels in search of carrion. Since mine development impacted elk winter range, it is possible that development reduced potential wolverine winter foraging habitat by a small amount. The amount of ungulate winter range disturbed by Montana Tunnels is relatively small and unlikely to have resulted in substantial impacts to ungulates. Potential foraging habitat for wolverine is abundant.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for wolverine.

Western Toad
Impacts were evaluated based on occurrence of potential western toad habitat within the mine area and potential to impact western toad or their habitat. The effects analysis area is the operating permit area.

Western toad has not been documented at Montana Tunnels or within the baseline wildlife study area, although suitable habitat is present. Western toad reproduction has been documented in the Quartz Creek drainage, approximately 4 miles northwest of the Montana Tunnels Mine. L-Pit Plan mine development did not impact riparian habitat and wetland habitat. Potential toad breeding habitat has not been affected by mine development. Development of the mine may have resulted in the loss of a small amount of toad foraging habitat. Western toads may have been subjected to increased risk of mortality from mine traffic. Mine personnel observed “frogs” in the tailings pond. It is likely that these were spotted frogs, but there could be western toads using the tailings storage facility. The potential effects to toads resulting from exposure to low levels of metals and chemicals in the tailings storage facility are unknown and studies have not been conducted to evaluate the exposure potential. This exposure would occur during operations, but would end after the mine is reclaimed under all alternatives.

Alternative 1 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for western toad.

3.9.3.2 Alternative 2- Proposed Action Alternative (M-Pit)

The M-Pit Mine Expansion under Alternative 2 would increase the mine operating permit area by 269.8 acres and add 243.5 acres of new surface disturbance. Most of the new disturbance would affect Douglas-fir/grassland and grassland habitats. Approximately 7 acres of willow drainage bottom would be impacted (LeMieux 2006). Approximately 123.7 acres of previously reclaimed vegetation would be redisturbed.

The M-Pit Mine Expansion would impact about 4.77 acres of delineated wetlands as part of Alternative 2 (Montana Tunnels 2007). Approximately 2.64 acres would be excavated and removed by the expansion of the M-Pit rim and the relocated Clancy Creek channel. An additional 2.13 acres of wetlands would be temporarily impacted in the proposed wetlands mitigation area in order to complete the proposed mitigation. Montana Tunnels proposes to provide 5.13 acres of new mitigated wetlands in the broad Clancy Creek valley downstream of the relocated Clancy Creek channel to compensate for the loss of 4.77 acres for a wetlands mitigation ratio of approximately 1.14 to 1.

Impacts to wildlife from implementation of Alternative 2 would be similar to those described under the No Action Alternative, although impacts would be additive to those that have already occurred. Impacts primarily would be a result of additional loss of wildlife habitat. Additional habitat would be lost mostly through expansion of the M-Pit and waste rock storage areas. The amount of additional habitat loss is 243.5 acres.

M-Pit Mine Expansion would impact 7 acres of willow drainage bottom or riparian habitat. Riparian habitats are disproportionately important to wildlife species, particularly in arid and semi-arid environments. The highest densities of breeding birds are found in riparian habitats (Ohmart and Anderson 1988). Amphibians, such as spotted frog, may be exposed to increased risk of mortality resulting from the relocation of Clancy Creek. Amphibians upstream from the Clancy Creek diversion may be isolated from downstream populations during the life of the mine.

The loss of habitat would affect local wildlife populations until reclamation and wetlands mitigation returns wildlife habitat to a condition compatible with the habitat requirements of affected wildlife species. Wildlife dependent on previously undisturbed sites that would be disturbed by the M-Pit Mine Expansion may die or be displaced. Displaced animals may be forced into marginal habitats or may be incorporated into adjacent populations. Displaced animals may compete with animals that already occupy the unaffected habitats. Impacts to wildlife from habitat loss associated with development of the Montana Tunnels Mine were described by DSL (1985). DSL (1985) suggested that all wildlife habitat types potentially disturbed by mine development are abundant outside the permit area, and that unique habitats would not be lost. Riparian habitats are disproportionately important and often in limited supply. Similarly, ungulate winter range, particularly crucial winter range, may be a limiting factor for big game in the area. There is no mapped elk crucial winter range within the existing permit area or expansion area.

The M-Pit Mine Expansion could cause direct mortality to wildlife, primarily among wildlife that have low mobility. Small mammals and amphibians and reptiles in the M-Pit Mine Expansion area may be unable to escape heavy equipment during clearing of vegetation and relocation of Clancy Creek. If vegetation clearing occurs during late spring or early summer, active bird nests may be destroyed.

Implementation of Alternative 2 would delay implementation of mine reclamation and prolong the high level of human activity in the area. Displacement of species sensitive to human activity would persist until mining ceased and reclamation was complete. Filling the mine pit with water to create a pit lake would create aquatic habitat that may provide suitable resting habitat for migrating birds and serve as a water source for other birds and bats.

Under Alternative 2, Montana Tunnels would donate the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation to provide a location for business development following mine closure. This action would ensure that human activities persist in the area following mining. This continued human activity would likely result in ongoing disturbance to wildlife, at least in the mill area at a more limited scale.

Under Alternative 2, there would be additional loss of ungulate winter range. The additional habitat loss would be small relative to the initial loss of winter range that occurred during mine development. Additional displacement of ungulates would occur from implementation of Alternative 2. Disturbance to wildlife and physiological stress resulting from mining activity would persist for an additional 5 years. While revegetation of disturbed sites would provide forage for wintering ungulates, use of the mine facilities for future economic development would likely limit the habitat effectiveness of reclaimed and revegetated areas at the mine site near the facilities area. All big game species utilize riparian habitats, particularly moose, and there would be a loss of approximately 7 acres of riparian habitat used by moose. Rerouting Clancy Creek in a pipe during operations and ensuing disturbance in the drainage may reduce the effectiveness of the Clancy Creek drainage as a movement corridor for big game species.

Cumulative effects to big game and other wildlife species would be similar to those described under Alternative 1.

Threatened and Endangered Species

Impacts to threatened and endangered species would be similar to those described under Alternative 1. Future economic development at the Montana Tunnels Mine facilities area may result in the persistence of effects to threatened and endangered species resulting from human activity in the area. There would be no effect to grizzly bear or grizzly bear habitat under Alternative 2. Implementation of Alternative 2 may affect, but is not likely to adversely affect gray wolf and Canada lynx or their respective habitats.

BLM Sensitive Species

Impacts to BLM sensitive species would be similar to those described under Alternative 1. The additional loss of potential habitat for sensitive species would be additive to effects already incurred.

Disturbance to and loss of wetland and riparian habitats during mine expansion would affect BLM sensitive species that use those habitats. It is possible that western toads occur in the Clancy Creek drainage. Toads upstream from the Clancy Creek diversion

may become isolated from downstream populations during the life of the mine. Potential breeding and foraging habitat would be lost along the portion of Clancy Creek that would be diverted. The reclamation plan calls for wetland replacement downstream from the Montana Tunnels Mine. The mitigation site has sufficient area to create a minimum of 3.00 acres of wetlands. The wetlands mitigation may not replace the diversity that was afforded by smaller wetlands where the Clancy Creek channel was located prior to disturbance.

Implementation of Alternative 2 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for:

- Black-backed woodpecker
- Brewer's sparrow
- Flammulated owl
- Golden eagle
- Great gray owl
- Loggerhead shrike
- Northern goshawk
- Three-toed woodpecker
- Trumpeter swan
- Fringed myotis
- Long-eared myotis
- Long-legged myotis
- Townsend's big-eared bat
- Wolverine
- Western toad

3.9.3.3 Alternative 3- Agency Modified Alternative

The anticipated effects to wildlife under Alternative 3 would be less than described under Alternatives 1 and 2.

Limiting motorized travel in important winter and summer ranges would be beneficial to deer and elk. Donating the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation, but with the requirement of using only existing building sites and reclaiming other areas would also be beneficial.

There would be no effect to grizzly bear or grizzly bear habitat under Alternative 3. Implementation of Alternative 3 "May Affect, but is Not Likely to Adversely Affect" gray wolf and Canada lynx or their respective habitats.

Implementation of Alternative 3 may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species for:

- Black-backed woodpecker
- Brewer's sparrow
- Flammulated owl
- Golden eagle
- Great gray owl
- Loggerhead shrike
- Northern goshawk
- Three-toed woodpecker
- Trumpeter swan
- Fringed myotis
- Long-eared myotis
- Long-legged myotis
- Townsend's big-eared bat
- Wolverine
- Western toad

3.10 Fisheries and Aquatics

This section discusses the fisheries and aquatics analysis methods used, the affected environment under permitted conditions, and the environmental consequences of Alternatives 1, 2, and 3 as they relate to fisheries and aquatic resources. The affected environment was discussed in the 1986 final EIS on pages III-17 through III-20. The impacts to fisheries and aquatic resources from permitting the Montana Tunnels Mine were discussed in the 1986 final EIS under aquatics on page IV-13 and fisheries on page IV-14.

3.10.1 Analysis Methods

Analysis Area

The analysis area for aquatic resources and fisheries includes streams in the Pen Yan Creek, Spring Creek, and Clancy Creek drainages within or adjacent to the mine permit area.

Information Sources

Information for the analysis of aquatic resources and fisheries in the Montana Tunnels Mine area was found primarily in two WESTECH technical reports (Montana Tunnels 2007). Information related to aquatic resources was found in several other technical reports by Hydrometrics, Knight Piésold, and WESTECH submitted in support of the operating permit application and as part of the mine operating permit deficiency review process (Montana Tunnels 2006).

Methods of Analysis

Qualitative assessments of potential impacts to fisheries and aquatics resources were done using existing habitat and biological population status data as a baseline. Where data were not available or data gaps exist, best professional judgment, published research, or status reports were used to determine potential impacts or responses of biological populations to proposed alternatives.

Short-term impacts are defined as lasting during operations through the 5-year closure period. Long-term impacts are defined as those impacts that persist past the 5-year closure period. Adverse impacts may be either direct or indirect impacts caused by the proposed alternatives that are likely to decrease aquatic habitat or populations. Beneficial impacts are direct and indirect impacts caused by the proposed alternatives that are likely to increase available aquatic habitat, improve aquatic habitat conditions or otherwise benefit aquatic populations.

3.10.2 Affected Environment

Fisheries and aquatics

This section describes the aquatic environment and fish and aquatic invertebrate populations of the area potentially affected by the proposed Montana Tunnels M-Pit Mine Expansion. Within the area potentially affected by the proposed project, three streams are present: Clancy Creek, Pen Yan Creek, and Spring Gulch. All three streams support aquatic habitat, but only Clancy Creek is known to support a fish population within the mine area. The aquatic habitat and species populations described in this section serve as the baseline for determining impacts of the proposed alternatives.

Aquatic Habitat Characterization

Clancy Creek

Clancy Creek is a small (average annual flow of 0.56 cfs), first-order, perennial tributary to Prickly Pear Creek which is a tributary to the upper Missouri River. Total stream length is 11.5 miles, and total drainage area is approximately 1,000 acres. Clancy Creek flows adjacent to the northwest highwall of the L-Pit (**Figure 3.7-1**) for approximately 1,800 feet.

Clancy Creek originates from springs and historic mine adit discharges approximately 1 mile upstream of the existing mine pit in a steep, conifer-dominated canyon. Upstream (northwest), of the proposed M-Pit Mine Expansion area, riparian vegetation along Clancy Creek is characterized by a moderately open to closed tree canopy dominated by mature Douglas-fir and Engelmann spruce, a mid-story comprised of aspen and alder, and an understory dominated by low shrub and herbaceous species. The channel slope is moderate to steep through this reach and stream habitat consists of a step-pool sequence formed by shallow tree roots (Montana Tunnels 2007).

Adjacent to the existing L-Pit, the valley widens to approximately 200 to 400 feet, and riparian vegetation transitions to scrub-shrub wetland vegetation (alder and willow species) along the channel, with smaller patches of emergent wetland vegetation. An unnamed ephemeral tributary flows into Clancy Creek from the northwest within this reach (**Figure 3.7-1**). Ephemeral flows are generally observed only during snowmelt runoff periods in the spring.

Downstream of the proposed M-Pit Mine Expansion area, Clancy Creek continues to flow through a broad meadow and begins to lose flow until it reaches the confluence with Kady Gulch, approximately one-half mile downstream of the existing pit. The lower reach of Clancy Creek is intermittent during low precipitation years.

Clancy Creek was considerably altered by historical mining activities (excavations, roads, vegetation clearing, etc.) and by historical and present-day agricultural practices, primarily livestock grazing and hay production. Beaver dams and ponds, present in the early 1980s along portions of the stream, likely resulted in further alterations to aquatic habitat, such as channel movement and reduced sinuosity. Instream habitat is limited due to the impacts of these past and existing disturbances to the channel and riparian vegetation. Habitat is further limited by the stream's comparatively small size (1 to 4 foot channel widths) and irregular flow regime. Primary habitat limitations include reduced pool habitat and a lack of in-stream cover features.

Instream and streambank habitat conditions at four locations along Clancy Creek within the vicinity of the proposed mine permit expansion area were characterized by WESTECH in 2004 (Montana Tunnels 2007). These locations correspond with the four sampling stations established by WESTECH for aquatic invertebrate community sampling. The four sampling stations are shown in **Figure 3.10-1**. Sampling station 1 is located upstream of the proposed M-Pit Mine Expansion area. Sampling station 2 is located within the reach of Clancy Creek that would be diverted into a pipe during M-Pit Mine Expansion activities. Sampling station 3 is located within the proposed M-Pit Mine Expansion area, just downstream of the proposed Clancy Creek diversion return flow outlet. Sampling station 4 is located downstream of the proposed M-Pit Mine Expansion area. These sampling stations are located within fish population sampling reaches 2, 3, and 4 established by FWP in 2003 (**Table 3.10-1, Figure 3.10-2**). Aquatic habitat condition observations at each WESTECH sampling station are summarized in **Table 3.10-2**.

The proposed M-Pit Mine Expansion would eliminate 1,800 feet of Clancy Creek. Within this reach, the stream flows through a broad meadow dominated by introduced species, including timothy, redtop, smooth brome, and Kentucky bluegrass. Shrubs, primarily willow and alder, and aspen trees are present intermittently along the channel in the affected area (**Figure 3.10-3**).

Within this reach, the channel is 1 to 4 feet wide with sections incised between 1 and 2 feet, and shorter sections incised up to 6 feet. Channel incision is a likely result of past streambank disturbances described above, including removal of riparian vegetation, beaver dam construction and subsequent failure, and re-location of sections of the stream during mining- and non-mining-related construction activities. Channel changes due to construction and beaver activity likely shortened sections of the channel, increasing channel slope and resulting in channel incision that was more pronounced due to impaired riparian vegetation.

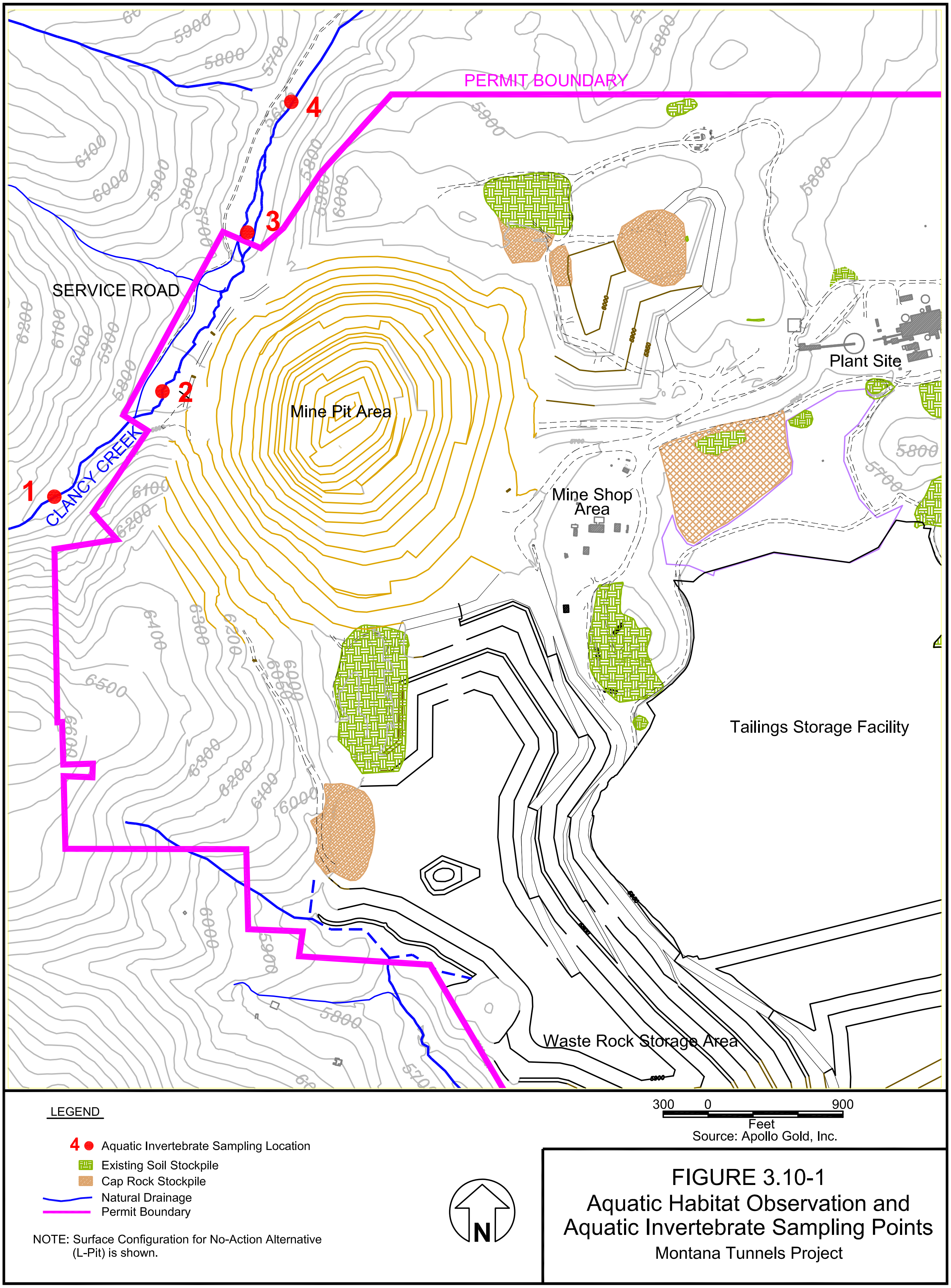
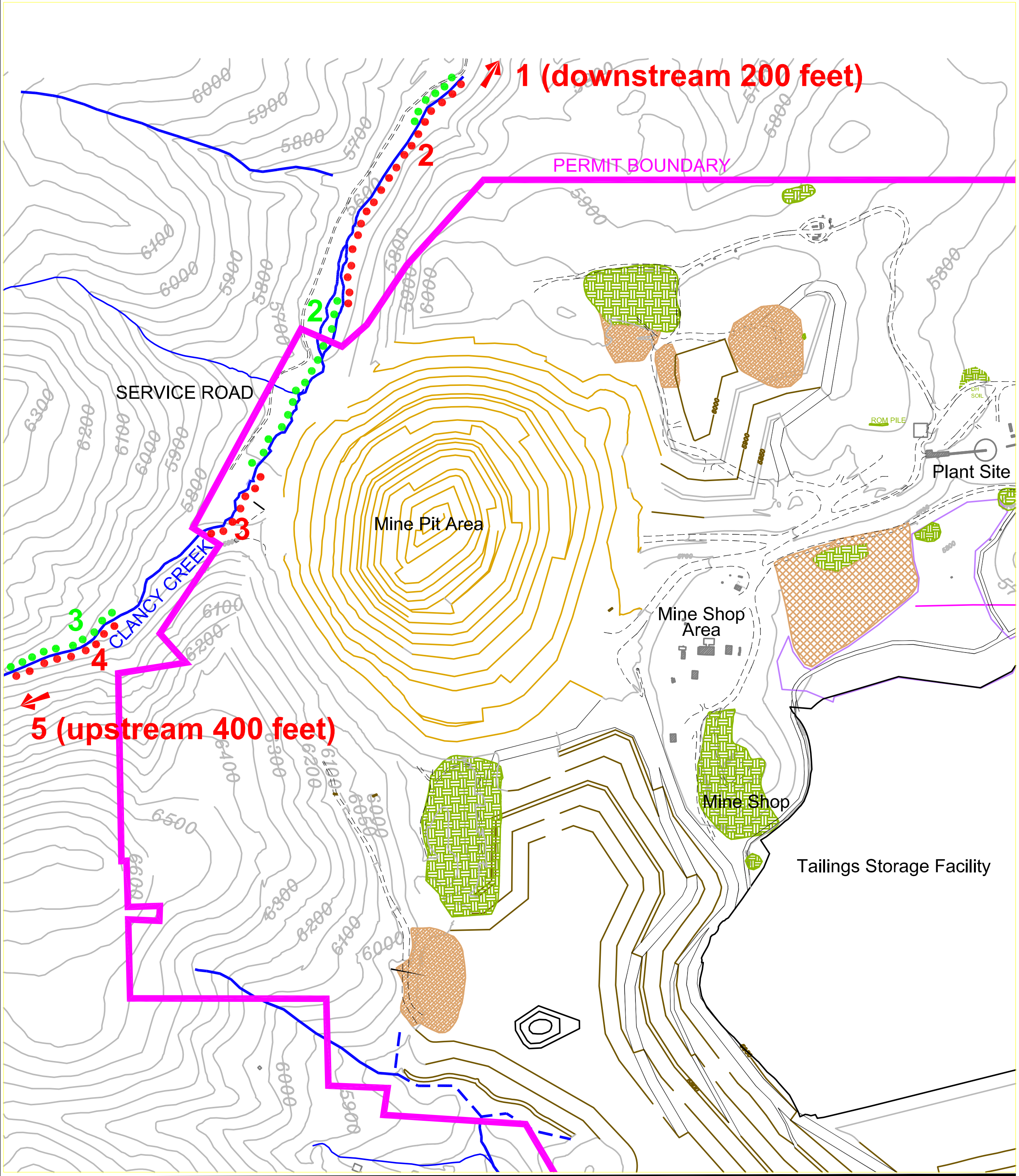


FIGURE 3.10-1
Aquatic Habitat Observation and Aquatic Invertebrate Sampling Points
Montana Tunnels Project



300 0 900
Feet
Source: Apollo Gold, Inc.

LEGEND

4 • 2003 Fish Wildlife and Parks Fish Sampling Reaches
4 • 2005 Forest Service Fish Sampling Reaches
Existing Soil or Gravel Stockpile
Cap Rock Stockpile
Natural Drainage
Permit Boundary

NOTE: Surface Configuration for No-Action Alternative (L-Pit) is shown.

N

FIGURE 3.10-2
Fish Sampling Reaches
Clancy Creek

Montana Tunnels Project

FIGURE 3.10-3
Existing Riparian and Stream Habitat Along Clancy Creek
Montana Tunnels Project

TABLE 3.10-1
CLANCY CREEK FISH POPULATION SURVEYS

Date	Sample Reach[b]	Reach Description	Results
August 21, 2003[a]	1	300 ft. sample from beaver dam at pump station to flume	43 brook trout for 578 seconds of sampling time
August 21, 2003[a]	2	From culvert at confluence of Kady Gulch upstream approx. 0.5 mi. through meadow near Montana Tunnels L-Pit; sampled best habitat in reach	1 brook trout, 9 unknown juvenile trout for 1,008 seconds of intermittent sampling time
August 21, 2003[a]	3	300 ft. sample from vehicle trail ford crossing near upper end of mine operating permit boundary	2 brook trout and 1 unknown trout fry for 711 seconds of sampling time
August 21, 2003[a]	4	Approx. 1,000 ft. sample starting at road crossing below old mine tailings about 0.3 mi. upstream from operating permit boundary	8 brook trout and 1 westslope cutthroat trout; no shocking time recorded
August 21, 2003[a]	5	Approx. 1,200 ft. sample between 2 unnamed headwater tributaries approx. 0.8 mi. upstream from operating permit boundary	2 westslope cutthroat trout; no shocking time recorded
September 29, 2005[c]	1	1,000 ft. sampling reach from confluence of Clancy Creek and Kady Gulch upstream	6 brook trout (all < 3″)
September 29, 2005[c]	2	1,000 ft. sampling reach in NE ¼ of section 8	23 brook trout (all <3″)
September 29, 2005[c]	3	0.4 mile sampling reach from Forest Service boundary upstream	18 brook trout (<3″) 15 brook trout (3-6″) 3 brook trout (>6″) 1 westslope cutthroat trout (3-6″) 2 westslope cutthroat trout (>6″)

Notes:

a Conducted by Montana Fish, Wildlife and Parks in 2003 (Spoon 2004).
b Sample Reaches are shown in **Figure 3.10-2.**
c Conducted by United States Forest Service in 2005 (Forest Service 2005).
Ft. Feet
> Greater than
< Less than
″ Inches

TABLE 3.10-2 HABITAT CONDITIONS AT CLANCY CREEK AQUATIC INVERTEBRATE SAMPLING SITES			
Sample Station[a]	**Streambank Habitat**	**Instream Habitat at Sample Station**	**Surber[b] sample substrates**
1	Open stand of Douglas-fir, Engelmann spruce, and alder with overhanging cover of alder, willow, and forbs.	Average stream width: 18-30 in. Avg. stream depth: 1-3 in. Substrate: 50% gravel/30% sand and sediment/20% cobbles Gradient: approx. 1.5% Turbidity: clear Water temp.: +47°F at 10:30 a.m. Air temp.: +75°F at 10:30 a.m. Miscellaneous: Small woody debris in water, minor bank undercutting. Channel altered by old mine/skid road (overgrown).	#1: 100% sand and sediment #2: 50% gravel, 50% sand/sediment #3: 20% cobble, 50% gravel, 30% sand/sediment
2	Stand of Douglas-fir and Engelmann spruce with overhanging alder. Generally open understory but some shade and cover provided by tree canopy.	Avg. stream width: 24-30 in. Avg. stream depth: 1-5 in. Substrate: 25% gravel/75% sand and sediment with occasional cobbles Gradient: approx. 1.5% Turbidity: clear Water temp.: +47°F at 11:00 a.m. Air temp.: +77°F at 11:00 a.m. Misc.: step-pool formation caused by tree roots. Small woody debris in water, minor bank undercutting. Channel altered by old flume/bypass. Spotted frogs present along streambanks.	#1: 20% gravel, 80% sand/sediment #2: 50% gravel, 50% sand/sediment #3: 50% gravel, 50% sand/sediment
3	Open, mature aspen stand in heavily grazed meadow dominated by timothy about 250 ft. below existing lower mine permit boundary.	Avg. stream width: 18-30 in. Avg. stream depth: 1-4 in. Substrate: 80% gravel/20% sediment with occasional cobbles Gradient: approx. 0.5% Turbidity: clear Water temp.: +54°F at 11:45 a.m. Air temp.: +82°F at 11:45 a.m. Misc.: some undercutting of banks on inside bends; otherwise, very little shade or overhead cover. Channel altered at some time in the past, apparently by beaver activity upstream; inactive channel nearby.	#1: 80% gravel, 20% sediment #2: 80% gravel, 20% sediment #3: 80% gravel, 20% sediment

TABLE 3.10-2
HABITAT CONDITIONS
AT CLANCY CREEK AQUATIC INVERTEBRATE SAMPLING SITES

Sample Station[a]	Streambank Habitat	Instream Habitat at Sample Station	Surber[b] sample substrates
4	Overhanging willow in a stand of open canopy, moderately to heavily grazed Douglas-fir/pinegrass approx. 0.1 mi. above culvert at Kady Gulch.	Avg. stream width: 24-36 in. Avg. stream depth: 0.5-2 in. Substrate: 70% sediment/20% sand/10% gravel Gradient: approx. 0.5% Turbidity: clear Water temp.: +56°F at 12:30 p.m. Air temp.: +84°F at 12:30 p.m. Misc.: some periphyton development on substrate. Gentle bank edges with no undercutting. Channel altered by small waste rock piles associated with historical mining.	#1: 90% sand/sediment, 10% gravel #2: 50% sand/sediment, 50% gravel #3: 75% sand/sediment, 25% gravel

Notes:

a	Sampling station locations are shown in **Figure 3.10-1**.
b	Surber refers to a type of aquatic invertebrate sampler consisting of a D-frame and net. The data in this column refers to the substrate captured in the sampler during aquatic invertebrate surveys and can be used to generally describe the type of substrate and each sampling location.
°F	Degrees Fahrenheit
%	Percent
#	Number
Approx.	Approximately
Avg.	Average
In.	Inches
Misc.	Miscellaneous
Temp.	Temperature

Water depth observed in late summer was 1 to 6 inches, and channel substrate was gravels with accumulations of fine sediment. Average channel gradient through the reach is 5.6 percent (Montana Tunnels 2007). Instream habitat within the affected area consists primarily of high-gradient riffle. Based on visual observations of the stream through this reach, instream cover in the form of woody debris and pools is generally lacking (Montana Tunnels 2007). Within sections of the 1,800-foot reach proposed for relocation, it is likely that some suitable trout spawning habitat is available. Sections with lower channel gradient; small, clean gravels; and proximity to cover (*e.g.*, overhanging streambanks) provide the most suitable spawning habitat. In addition, trout fry were found during fish surveys conducted in this reach of Clancy Creek (**Table 3.10-1)**, indicating that spawning likely occurs within or near the area.

Water quality is described in detail in Section 3.7, and is generally good in Clancy Creek with low concentrations of nutrients and generally low concentrations of metals (Montana Tunnels 2007). Water quality has historically been impacted by mining activities that predate the Montana Tunnels Mine (see Section 3.7). Water temperatures recorded during aquatic invertebrate sampling in August 2003 were 47° F for sites further upstream and 57° F for sites further downstream. These data indicate that temperatures are within the thermal requirements of trout species occurring in the stream (Bear and others 2005).

In summary, the section of Clancy Creek that would be diverted under the proposed M-Pit Mine Expansion provides moderate habitat for aquatic species. Fish populations and aquatic invertebrate communities are described later in this section.

Pen Yan Creek

Pen Yan Creek is a small intermittent and ephemeral tributary stream to Spring Creek, which is a tributary to Prickly Pear Creek. Pen Yan Creek is located along the southern boundary of the existing Montana Tunnels Mine operating permit area (**Figure 3.7-1**). Aquatic habitat in Pen Yan Creek is reduced by variable flows, poor water quality and historic alterations. Water quality and quantity in Pen Yan Creek are described further in Section 3.7.

Pen Yan Creek has been historically altered by tailings deposition and the diversion of water for use in mine operations. Instream habitat is considered to be severely degraded for the length of the stream (Montana Tunnels 2007). The Pen Yan Creek stream channel varies along its length, but is generally shallow (1 to 3 inches) and narrow (1 to 3 feet) with interrupted flow over steep (6 to 10 percent) gradients. Sections of the stream were incised into mine tailings, resulting in over-widened gullies and loss of a defined channel. Much of the streamflow was diverted into a pipe near a historic mine, which routes water around the mine waste and tailings piles. The pipe discharged near the lower slopes south of a historic waste rock pile. The Pen Yan Creek channel through the old mine area was reclaimed during 2007. The stream channel

loses a defined channel below this discharge area and becomes a shallow wetland dominated by redtop, Baltic rush, and small-winged sedge. This wetland has no discernible surface flow during periods of runoff. Pen Yan Creek enters a sedimentation pond near the southeast corner of the Montana Tunnels operating permit area and then is routed to the south pond, where the water is used for the mine's milling process. At present, no surface flow from Pen Yan Creek leaves the mine area.

The M-Pit Mine Expansion includes expanding the main waste rock storage area to the south, which would result in abandoning and covering 3,800 feet of the Pen Yan Creek channel. The natural Pen Yan Creek channel would be relocated into a constructed channel.

Due to the ephemeral nature of the stream, degraded water quality, and lack of downstream connectivity with perennial streams, Pen Yan Creek provides poor quality aquatic habitat and does not support or have the potential to support a fish population (**Figure 3.10-4**). Aquatic invertebrate communities appear to be limited (Montana Tunnels 2007).

Spring Gulch

Spring Gulch, the upper portion of Spring Creek within the southeast corner of the operating permit, is a small, ephemeral, discontinuous tributary to Prickly Pear Creek (**Figure 3.7-1**). Spring Gulch is ephemeral at and above the confluence with Pen Yan Creek and carries water only during spring run-off. During run-off, the concentrations of arsenic, cadmium, and lead in the stream at times exceed DEQ-7 aquatic criteria (DSL 1986). Downstream of the confluence with Pen Yan Creek, there is no defined channel in Spring Gulch for more than a mile. The stream enters a broad valley floor in this area and any flows from precipitation runoff rapidly infiltrate into the surface gravels.

Spring Gulch would not be rerouted as a result of the proposed M-Pit Mine Expansion, but is included as affected environment because it flows within the operating permit area and is therefore potentially affected by the proposed expansion.

Due to the ephemeral nature of the stream, degraded water quality, and lack of downstream connectivity with perennial streams, Spring Gulch does not support or have the potential to support a fish population, and aquatic invertebrate communities are limited (Montana Tunnels 2007).

FIGURE 3.10-4
Existing Riparian and Stream Habitat
Along Pen Yan Creek
Montana Tunnels Project

Fish Populations

Clancy Creek

Fish populations were sampled from five locations in Clancy Creek in 2003, by FWP personnel (Spoon 2004) and three locations in Clancy Creek in 2005 by U. S. Forest Service (USFS) personnel (Forest Service 2005). Results of FWP and USFS sampling are described in **Table 3.10-1**. Locations of the five FWP and three USFS sampling reaches in relation to the proposed M-Pit Mine Expansion area are shown in **Figure 3.10-1**. For the 2003 sample, sample reach 1 is located well downstream of any proposed M-Pit Mine Expansion-related disturbance. Part of sample reach 2 is downstream of the proposed expansion and part of sample reach 2 lies within the expansion area. Sample reach 3 would be disturbed and/or flow would be modified by the proposed Clancy Creek diversion under Alternative 2. Sample reaches 4 and 5 are located upstream from any M-Pit disturbance associated with the Proposed Action. For 2005 sampling, sample reach 1 begins at the confluence of Clancy Creek and Kady Gulch and extends 1,000 feet upstream. Sample reach 2 is 1,000 feet long and located within the existing and proposed mine operating permit boundaries. Sample reach 3 begins at the USFS boundary at the upstream end of the proposed mine permit boundary and extends 0.4 mile upstream.

Results of 2003 and 2005 fish population sampling are reported in **Table 3.10-1**. In 2003, westslope cutthroat trout (*Oncorhynchus clarki lewisi*) were observed in low densities above the existing L-Pit (sample reaches 4 and 5, n=3). Westslope cutthroat trout are listed as a sensitive species by the USFS and as species of special concern by the Montana Chapter of American Fisheries Society and the FWP. Eastern brook trout (*Salvelinus fontinalis*), an introduced species to Montana, were present in moderate densities downstream of the proposed M-Pit Mine Expansion area (sample reach 1, n=43). Within the proposed M-Pit Mine Expansion area (sample reaches 2 and 3), 2 brook trout were observed, in addition to 10 unknown juvenile trout. In 2005, no westslope cutthroat trout were captured in sample reaches 1 and 2, within the vicinity of the mine. The only fish sampled in these reaches were juvenile eastern brook trout (n = 6; n = 23). In reach 3, upstream of the mine, 3 cutthroat trout and 36 eastern brook trout were sampled in 2005. This survey reported that, based on these findings, westslope cutthroat trout in upper Clancy Creek are near extinction (USFS 2005).

In addition to fish sampling conducted in 2003 and 2005, samples of westslope cutthroat trout were collected in 1997 to test for hybridization with rainbow trout. Hybridization was tested in a sample of 10 westslope cutthroat trout collected in stream miles 10.6 to 10.7, and five fish collected in stream miles 11.2 to 11.3. The results of genetic sampling in upper Clancy Creek showed no hybridization with non-native species (Naisha 1998).

The results of this sampling differ from prior sampling conducted in October 1984 by FWP and reported in DSL (1986) and by WESTECH in Montana Tunnels (2007). During prior sampling, 27 westslope cutthroat trout were observed in a 1,000-foot sample reach of Clancy Creek above the confluence of Kady Gulch. This reach corresponds approximately with FWP sample reach 2 described above, where only 1 brook trout and 9 unidentified juvenile trout were observed in 2003. No other trout species were caught above the confluence of Kady Gulch in 1984 sampling, although brook trout, rainbow trout, and brown trout were captured farther downstream in Prickly Pear Creek (DSL 1986). These species are present below the diversion structure located on Clancy Creek, just downstream of the Kady Gulch confluence. This diversion structure is operated by Montana Tunnels and functions as an upstream barrier to fish migrating from lower Clancy Creek and Prickly Pear Creek.

Results suggest that fish populations have changed in the portion of Clancy Creek from the confluence of Kady Gulch upstream through the vicinity of the Montana Tunnels Mine proposed M-Pit Mine Expansion area since 1984. In general, fewer fish are currently present and the species composition appears to have shifted from predominantly westslope cutthroat trout in 1985 to predominantly eastern brook trout in 2005. However, sampling completed to date does not clearly show a competitive dominance of brook trout over westslope cutthroat trout in Clancy Creek due to the low overall number of individual fish sampled.

Seasonal movement likely accounts for some of the variability between samplings; however, the reduced number of fish could also be a result of altered flows and habitat alterations. Drought conditions, in conjunction with channel alterations resulting from historic mining that predates Montana Tunnels, grazing, historic road construction, and beaver activities, may have disrupted fish distribution and movement, as well as available fish habitat in the project reach. These alterations may provide a competitive advantage for brook trout. Brook trout out-compete juvenile cutthroat trout for food (Novinger and Rahel 1999), and the difference in species composition between 1984 and 2005 may indicate the upstream migration and dominance of brook trout over westslope cutthroat trout resulting in a decline in cutthroat trout numbers since the 1984 sampling. Competition with nonnative species, such as brook trout, has led to a reduction in westslope cutthroat trout populations in Montana, but the specific mechanisms involved have not been clearly demonstrated (Griffith 1988).

Pen Yan Creek

Pen Yan Creek does not support fish and the potential for supporting fish is extremely low. Pen Yan Creek has severely degraded instream and streambank habitat, impaired water quality, and irregular flows. Pen Yan Creek has no downstream or upstream connection to a fish-bearing stream.

Spring Gulch

Spring Gulch, the upper portion of Spring Creek within the project limits, does not support fish and the potential for supporting fish is extremely low. Spring Gulch at and above the confluence with Pen Yan Creek is ephemeral. Downstream of the confluence with Pen Yan Creek, Spring Gulch has no defined channel and all flows infiltrate into the ground. Spring Gulch has no connection to a perennial stream.

Angler Use

According to WESTECH, Clancy Creek over its entire length receives limited sport fishing use (Montana Tunnels 2007). Above Kady Gulch, there are so few fish that fishing pressure is likely low. There is no public access inside the mine operating permit boundary (**Figure 3.7-1**), so there are no opportunities for public use of this area. Above the mine, the stream size likely limits fishing opportunities.

Aquatic Invertebrate Populations

Clancy Creek

Aquatic invertebrates in Clancy Creek were sampled at four locations in 2004, by WESTECH in the vicinity of the proposed M-Pit Mine Expansion area (**Figure 3.10-1**). Details on sampling methods and protocols are described in an accompanying report by WESTECH (Montana Tunnels 2007). Habitat conditions recorded at each sampling site are described in **Table 3.10-2**.

Metrics calculated from individual aquatic invertebrate samples at each of the four sample stations are presented in **Table 3.10-3**. DSL (1986) reported that the mean total number of organisms collected from sample stations in the upper Clancy Creek drainage in 1984 was 868. In comparison, the mean total number collected in 2003 was 762 (**Table 3.10-3**), about 12 percent less than the 1984 mean. The difference in total number of organisms could be a result of differences in site conditions where samples were collected. The majority of sampling completed in Clancy Creek in 1984 was done downstream of the confluence with Kady Gulch, where streamflows are higher, which increases the habitat available for additional species to occupy.

TABLE 3.10-3
CLANCY CREEK AQUATIC INVERTEBRATE SAMPLE DATA

Sample Station	Sample	Total Abundance	Taxa Richness	Percent Dominant Taxon	EPT Richness	Percent Chironomidae	EPT: Chironomidae	Scraper: Filter	% Filterers
1	1	66	18	33.3	7	6.7			
	2	101	19	18.8	12	7.9			
	3	177	19	37.9	12	37.9			
	Total	344							
	Mean		34	23	19	23	1.89	1.08	7.85
2	1	277	29	19.9	17	12.2			
	2	563	33	26.1	19	6.8			
	3	719	35	24.4	25	7.1			
	Total	1559							
	Mean		44	19.7	26	7.9	5.94	1.12	2.95
3	1	142	25	30.3	12	30.3			
	2	125	19	22.4	13	20.8			
	3	233	23	17.2	12	17.2			
	Total	500							
	Mean		31	21.8	19	21.8	1.95	0.93	2.80
4	1	199	14	37.7	7	24.6			
	2	136	17	27.9	9	11.0			
	3	309	21	39.2	12	13.6			
	Total	644							
	Mean		27	36.3	14	16.5	3.05	0.86	1.09
	Mean all Clancy Creek sampling stations	762	33.8	27.7	19.5	16.3	1.62	1.06	3.09

TABLE 3.10-3
(Continued)
CLANCY CREEK AQUATIC INVERTEBRATE SAMPLE DATA

Notes:

Total abundance = Total number of individuals sampled. Number is variable in response to environmental stress.

Taxa richness = Total number of unique taxa in the sample. Number decreases with increasing environmental stress.

EPT richness = Number of unique species among the orders *Ephemeroptera*, *Plectoptera*, and *Trichoptera*. Number decreases with increasing environmental stress.

Percent dominant taxa = Percentage of the taxon with the largest number of individuals out of the total number of aquatic invertebrates in the sample. Percentage increases with increasing environmental stress.

Percent Chironomidae = Percentage of number of Chironomidae individuals out of total number of aquatic invertebrates in sample. Percentage increases with increasing environmental stress.

EPT: Chironomidae = Ratio of total EPT richness to total number of Chironomidae individuals. Number decreases with increasing environmental stress.

Scraper: Filter = Ratio of total number of individuals of scraper feeding group to total number of individuals of filter feeding group. Number is variable in response to environmental stress.

Percent filterers = Percentage of number of individuals out of total number of aquatic invertebrates in sample in the filter feeding group. Percentage decreases with increasing environmental stress.

Overall, the Clancy Creek drainage supports a high diversity, but relatively low total numbers, of aquatic invertebrates. This condition is similar to other high quality streams in western Montana. Metrics calculated for samples collected from Clancy Creek in 2003 were compared with regional values for mountain streams in Montana compiled by Bahls and others (1992). Based on this comparison, both the 1984 and 2003 aquatic invertebrate samples collected in upper Clancy Creek suggest the stream health (biotic condition) is typical of other Montana mountain streams.

Clancy Creek sampling sites had an average taxa richness score of 26 to 44 (mean = 34) for 2003 data and a mean score of 28 for 1984 data (DSL 1986). These scores were above or near the average taxa richness value of 29 percent typical of mountain streams in Montana (Bahls and others 1992). Bahls and others (1992) found a mean EPT richness of 22 for mountain streams in Montana, compared with 19.5 (Range= 12-26) for 2003 data collected for Clancy Creek. Bahls and others (1992) report an average value of 9 percent for mountain streams in Montana for the percent Chironomidae metric (Chironomidae is a family of midges and accounts for most of the aquatic invertebrates in freshwater environments). The mean Chironomidae metric for 2003 samples from Clancy Creek was about 16 percent (range= 7.9-21.8).

The percent Chironomidae metric generally increases with a decrease in water quality and generally indicates whether a stream is oligotrophic (nutrient poor) or eutrophic (nutrient rich). Some Chironomidae are relatively tolerant of heavy metals McGuire 1999). Although the metric is higher for Clancy Creek sampling sites compared with the regional value, the values are still relatively low and do not necessarily represent degraded water quality or habitat.

The most common types of aquatic invertebrates found in Clancy Creek are clean-water forms such as mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), representing greater than 40 percent of the total species composition at each sampling site.

Differences between samples within a sampling site were influenced primarily by the available substrate. In general, sites dominated by larger substrate particles (*e.g.*, cobbles) supported a greater percentage of Ephemeroptera (mayflies). Samples dominated by small particles, particularly sand and sediment, tended to have lower diversities but sometimes had greater total numbers of organisms. Differences between samples collected at different sampling sites may reflect the downstream increase in water temperature and general increase in small particle size substrate (sand and sediment).

Pen Yan Creek

Due to the degraded and ephemeral nature of Pen Yan Creek, it would not support diverse aquatic invertebrate populations and no samples were collected. Aquatic invertebrate communities appeared to be limited based on visual observations made in 2003 by WESTECH personnel (Montana Tunnels 2007). In a few isolated seeps or pools of water, low numbers of aquatic invertebrates (dominated by Hemiptera and Chironomidae) were present. These areas likely represent small pockets where water is present for longer periods of time, and sediments are somewhat less degraded (Montana Tunnels 2007).

Spring Gulch

Due to the degraded and ephemeral nature of Spring Gulch, it would not support aquatic invertebrate populations, and no samples were collected or observations on aquatic communities recorded (Montana Tunnels 2007).

3.10.3 Environmental Consequences

3.10.3.1 Alternative 1 – No Action Alternative (L-Pit)

Aquatic Habitat

Under Alternative 1, aquatic habitat would change over time due to natural cycles, such as fluctuations of streamflow and water temperature. Other activities in the project area, such as mining not related to this proposal, subdivisions, roads, grazing, timber harvest or restoration would have potential for adverse and beneficial impacts on aquatic habitat. The Clancy Creek channel would not be excavated and removed by M-Pit Mine Expansion under this alternative and no impact to the Clancy Creek channel is predicted for Alternative 1 in the foreseeable future.

Impacts of Alternative 1 on Clancy Creek stream flows and water quality, including those caused by flood events are described in Section 3.7. During active mining, Montana Tunnels would continue to divert between 0.11 and 0.56 cfs of flow from Clancy Creek at a point of diversion downstream of Kady Gulch between September and May of each year. This is a short-term impact on aquatic habitat in Clancy Creek. After mining, these flows would no longer be appropriated, which would be a long-term beneficial impact to aquatic habitat in Clancy Creek. Under the No Action Alternative, no stream flows would be diverted from Clancy Creek upstream of the pit for use in filling the mine pit, therefore there would be no adverse impact from reduced flows on available aquatic habitat in Clancy Creek.

Pen Yan Creek is permitted to be diverted by expansion of the waste rock storage area in Alternative 1, but Montana Tunnels has indicated that it would not be diverted under the L-Pit Mine plan. Reclamation of a portion of the Pen Yan Creek drainage in 2007 would increase the potential for aquatic habitat to develop over time.

Fish and Aquatic Invertebrates

Fish and aquatic invertebrate populations in the project area would also change over time due to natural cycles. Sampling completed in 1997 showed the westslope cutthroat trout present in Clancy Creek upstream of the current L-Pit operating permit boundary to be genetically pure (Naisha 1998). This population is at risk of extinction primarily due to competition from other non-native species such as brook trout. This threat would not change under Alternative 1.

No fish or aquatic invertebrate populations are known to be present in Pen Yan Creek or Spring Gulch, and aquatic habitat in both streams is degraded. Fish and aquatic invertebrate populations are present in the Spring Creek drainage downstream of Spring Gulch, but there is no defined channel in Spring Gulch downstream of the Pen Yan Creek confluence for more than a mile. These populations are not connected to streams in the operating permit area.

3.10.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Aquatic Habitat

Under Alternative 2, aquatic habitat of two streams, Clancy Creek and Pen Yan Creek, would be directly affected by the Proposed Action. This alternative includes expansion of the M-Pit at the northwest side of the pit, which would remove the channel, riparian vegetation, underlying alluvium, and associated wetlands along approximately 1,800 feet of Clancy Creek. The habitat to be lost under this alternative is described in the Affected Environment section (aquatic invertebrate sampling sites 2 and 3), and generally consists of moderate quality habitat. This section of channel would be replaced with a 2,000-foot, 16-inch pipe resulting in a long-term adverse impact to aquatics under this alternative.

After mining operations cease, a portion of Clancy Creek flows would be used to flood the mine pit in perpetuity. There would be no outflow from the pit lake to downstream Clancy Creek. The flooded pit would not be managed as a fishery, but it is possible that fish from Clancy Creek upstream of the pit diversion could enter the filling pit. The quality of habitat in the pit lake would depend on resulting water quality (see **Section 3.7**), and the types of habitat that develop, particularly the presence of shallow water habitat at lake margins and cover features such as vegetation, rocks, or logs occurring at various stages as the pit fills with water.

Other aquatic habitat alterations resulting from Alternative 2 include a 600-foot-long constructed open channel to convey Clancy Creek flows downstream of the diversion pipe outlet. The pipe outlet is the location for the mitigation site for the loss of the Clancy Creek stream and associated wetlands and would consist of a wetland area fed by a portion of flows from Clancy Creek, and by all surface and subsurface flows associated with the ephemeral drainage entering Clancy Creek at the pipe outlet. The constructed channel has proposed dimensions much larger and steeper than the natural channel (18 feet wide by 4 feet deep) for easier construction and conveyance capacity for the combined 1:5 year flows from Clancy Creek and the ephemeral channel that enters Clancy Creek adjacent to the mine pit. Because of the larger channel dimensions, the quality of habitat in this channel would be reduced compared with the existing channel. Long term, it is likely that natural habitat features such as pools and cover from riparian vegetation would form in and along the constructed channel. Construction of this channel would be a short-term adverse impact on aquatic habitat in Clancy Creek.

Impacts to Pen Yan Creek would be similar to those permitted for Alternative 1, but, in the Proposed Action Alternative 2, disturbance would actually occur. At the southwest side of the mine permit area, waste rock storage area expansion would cover approximately 3,800 feet of an ephemeral portion of Pen Yan Creek. Pen Yan Creek would be relocated into a constructed channel and routed back into the sedimentation pond. The existing aquatic habitat in Pen Yan Creek is highly degraded, even with reclamation of some historic mine disturbance in 2007. Under this alternative, a new channel would be constructed to replace the covered portion of Pen Yan Creek. Loss of aquatic habitat in this reach of Pan Yan Creek and replacement with similar constructed habitat would not affect overall aquatic habitat quality. The realigned portion of the Pen Yan Creek channel would be 1,440 feet longer than the natural channel from the point of diversion to the sedimentation pond. This provides a potential long-term beneficial increase in available aquatic habitat.

Impacts to water quantity and quality under this alternative are discussed in Section 3.7. Under Alternative 2, the flow regime in Clancy Creek would be altered through a loss in surface area, diversion of a portion of peak stormwater flows into the mine pit and diversion of appropriated water downstream of the mine pit. This reduction in streamflows would result in a long-term adverse impact on aquatic habitat. Under this alternative, in-stream flows in Clancy Creek would be maintained during mining operations and during the period after mining to maintain habitat. The amount and timing of water to maintain this habitat has not been determined. The amount and timing of flows to be maintained in Clancy Creek downstream of the M-Pit Mine Expansion area would determine the long-term impact to aquatic habitat downstream of the mine pit. After mining, appropriated water would no longer be diverted from Clancy Creek downstream of Kady Gulch. This would be a long-term beneficial impact to aquatic habitat.

Surface water runoff that is diverted away from the Pen Yan and Spring Gulch drainages would have little impact on aquatic habitats. Both drainages are ephemeral and overlay glacial outwash colluvium which allows surface water to rapidly drain into the ground. The perennial section of Spring Creek downstream of the mine site maintains a substantial flow all year long, but is not connected via surface flows to Spring Gulch or Pen Yan Creek; therefore, changes in flow from the surface water diversion are not expected and no changes are anticipated to aquatic habitat in Spring Creek.

No long-term adverse impacts to water quality in Clancy Creek are anticipated under Alternative 2 and no changes to water quality in Pen Yan Creek and Spring Gulch would occur. Short-term increases in sediment delivery to Clancy Creek, Prickly Pear Creek, and Spring Gulch would occur as a result of construction activities related to relocation of Pen Yan and Clancy Creeks (see Section 3.7). Spring Gulch does not have an open channel connection with Spring Creek, so there would be no temporary increases in fine sediment levels in aquatic habitat. The short-term increase in fine sediment levels in Clancy Creek would be mitigated through construction best management practices but would be a short-term adverse impact to aquatic habitat.

Fish

Routing of Clancy Creek into a pipe during M-Pit Mine operations under Alternative 2 would result in direct and indirect impacts to fish populations. Under this alternative, 1,800 feet of Clancy Creek channel would be permanently lost. The loss of 1,800 feet of channel would result in a long-term reduction of diversity and abundance of aquatic life within the stream. Existing data on fish in Clancy Creek preclude estimating population size because of the small number of fish sampled. It is difficult to quantify the potential impact to the population resulting from the loss of this section of channel.

During M-Pit operations, it is likely that some fish from upper Clancy Creek would become entrained in the M-Pit diversion and lost from the population. The number of fish that would enter the M-Pit during operations would likely be small because only a small portion of streamflows at peak discharges would be diverted to the M-Pit during operation. Following mine closure, the majority of Clancy Creek stream flows would be diverted into the pit lake. After several decades, the quality of the M-Pit lake water would be suitable for fish survival and there would likely be sufficient food sources for fish to exist in the lake (see Surface Water Section 3.7).

The 2,000-foot-long pipe used to convey Clancy Creek would present a complete barrier to upstream migration of fish in Clancy Creek. Approximately 1.5 miles of Clancy Creek is present upstream of the proposed diversion pipe. This section of stream would become isolated from the lower portion of Clancy Creek. The fish population upstream of this diversion point consists predominantly of eastern brook trout, with small numbers of westslope cutthroat trout (**Table, 3.10-1, Figure 3.10-2**). Sufficient

information on life history parameters of the trout population in Clancy Creek is not available to determine if the fish population above the pit would persist if isolated from the rest of Clancy Creek. Due to competition from brook trout and reduced area of available habitat, isolation of this portion of the population may increase the risk of westslope cutthroat trout extinction in the drainage.

Resident trout populations confined to fragmented upper headwater habitats can increase their risk of extinction (Rieman and others 1993). A study by Hilderbrand and Kershner (2000) estimated that more than 5 miles of stream were required to maintain a cutthroat trout population with high fish abundances (0.3 fish/3.28 feet), and 15 miles of stream were required to maintain a population of low abundance (0.1 fish/3.28 feet). In addition, a population living in an isolated stream fragment with low habitat complexity probably requires more area to persist than a population of the same size living in a highly complex habitat (Novinger and Rahel 1999, Horan and others 2000). Habitat upstream of the pipe diversion is high gradient and lacks deep pools and spawning habitat. Disconnecting the upstream reach of Clancy Creek from the rest of the stream would be a long-term adverse impact to westslope cutthroat trout in Clancy Creek and possibly a long-term adverse impact to eastern brook trout in Clancy Creek.

Short-term adverse impacts on fish in Clancy Creek by channel disturbances and increased fine sediment levels associated with construction and realignment of the Clancy Creek channel would occur under this alternative. Effects would include temporary displacement of fish from the project area and potential destruction of fish caught in the abandoned channel.

Aquatic invertebrates

Alternative 2 has the potential to reduce the abundance and diversity of aquatic invertebrates in Clancy Creek and Prickly Pear Creek through direct loss of aquatic habitat and loss of connectivity with upstream invertebrate populations. Sufficient information is not available to estimate the biomass loss of aquatic invertebrates within the 1,800 feet of Clancy Creek that would be lost under this alternative, because only one sample was collected within the affected reach, which does not represent the range of available habitats. It is unlikely that substantial aquatic invertebrate diversities or densities would develop in the 16-inch, 2,000-foot diversion pipe, and minimal drift from upstream populations would occur through the pipe. The loss of available habitat would result in a short-term reduction in diversity and abundance, but would likely not be sufficient to result in a long-term adverse impact to the aquatic invertebrate populations in the Prickly Pear drainage.

Aquatic invertebrate populations would likely shift in response to habitat changes that would occur under Alternative 2. Construction of wetland features at the intake and outlet of the diversion pipe during operations, and diversion of Clancy Creek into the pit lake once filling is complete, would result in creation of new habitat. Wetland and

lake environments provide different available habitats for aquatic invertebrate populations and would likely have a slightly different species composition compared with other habitats found in Clancy Creek. The constructed channel downstream of the pipe outlet would present slightly different habitat conditions compared with existing habitat. The constructed channel would be larger and steeper than the existing natural channel, would consist of more uniform substrate, and would lack organic materials, at least in the short term.

Rate of aquatic invertebrate colonization in recently disturbed channels can vary greatly (Reice 1985). Colonization depends on invertebrate mobility (drift, swimming, crawling, and flight), substrate texture and associated food supplies, competition, and predation. For example, some feeding groups of aquatic invertebrates, such as browsers and filter feeders can use the resources of smooth stones; gatherers colonize as fine detritus accumulates; grazers increase as periphyton becomes established; and shredders and predators tend to be late arrivals (Mackay 1992**).** It is likely that an aquatic invertebrate population would colonize the channel within weeks or months after construction, depending on upstream populations, substrate, and streamflows.

In addition, short-term adverse impacts to aquatic invertebrate populations downstream of the M-Pit Mine Expansion area may occur during realignment and construction of the Clancy Creek channel through increased sediment delivery. The potential short-term increase in fine sediment levels in Clancy Creek would be mitigated through construction best management practices and is not expected to have any long-term adverse impacts on aquatic invertebrate populations.

Pen Yan Creek and Spring Gulch are known to support limited aquatic invertebrate populations. Little impact to aquatic invertebrates in these streams would occur as a result of Alternative 2.

3.10.3.3 Alternative 3 – Agency Modified Alternative

Aquatic Habitat

Impacts to aquatic habitat would be less for Alternative 3 than Alternative 2. During operations, Alternative 3 includes construction of an open-flow channel around the mine pit that would mimic the present Clancy Creek channel and habitat features. Under Alternative 3, flows from Clancy Creek would not be used to fill the mine pit. Adverse impacts described under Alternative 2 resulting from decreased flows in Clancy Creek would not occur. No long-term adverse impacts to aquatic habitat would occur under Alternative 3. A 200-foot buffer distance would be left between the M-Pit rim and the constructed channel, which would further provide for natural channel function and riparian vegetation development. Restoration of Clancy Creek through construction of a stable open-flow channel, enhancement of in-stream habitat features

and restoration of riparian vegetation would result in a long-term beneficial impact to aquatic habitat. The restored channel area should be fenced to discourage cattle grazing and other channel disturbances in order to preserve habitat long term.

Fish

Impacts to fish populations for Alternative 3 would be less than Alternative 2 during mine operations. During operations, Clancy Creek would be routed to a constructed open-flow channel. This would be more beneficial to fish populations relative to Alternative 2 because it would not result in loss of available habitat, and could result in a long-term improvement to aquatic habitat if the constructed open-flow channel consists of enhanced habitat features compared with the existing channel. Under Alternative 3, any westslope cutthroat trout in upper Clancy Creek would continue to be at risk of competition with brook trout. It is difficult to quantify this risk, because the status of this population is unclear due to the small numbers of fish sampled in 2003 and 2005. Restoration of the constructed open-flow channel and riparian vegetation would result in a long-term beneficial impact to fish populations in upper Clancy Creek. The existing Montana Tunnels water diversion intake downstream of Kady Gulch, currently functions as a barrier to upstream fish migration because the fish population structure above this diversion consists of only two species, westslope cutthroat trout and eastern brook trout. Enhancement of the diversion to ensure it remains a barrier in the future would reduce the potential for colonization of upper Clancy Creek by additional introduced fish species. Maintaining this diversion as a barrier to prevent upstream migration of other fish species would allow for potential restoration of the westslope cutthroat trout population in the future, including active removal of brook trout if necessary, to occur in the future.

Aquatic invertebrates

Under Alternative 3, impacts to aquatic invertebrates would be less than Alternative 2 during mine operations. During M-Pit mining operations, Clancy Creek would be routed to a constructed open-flow channel. The length of time for aquatic invertebrates to colonize newly available habitat varies depending on distance from existing populations and channel conditions, but it is likely that a diverse population of aquatic invertebrates would colonize the new channel relatively quickly (weeks to months). For Alternative 3, habitat conditions would be present that are more appropriate for aquatic invertebrate populations typical of headwater streams, and a long-term beneficial impact is expected.

3.11 Socioeconomics

The employment (pages III-41 through III-48), income (pages III-48 through III-57), fiscal (pages III-57 through III-70), and sociology (pages III-70 through III-89) resources affected environments were discussed in the 1986 final EIS (DSL 1986). The impacts to employment (pages IV-35 through IV-42), income (pages IV-2 through IV-47), fiscal (pages IV-55 through IV-59), and sociology (pages IV-47 through IV-55) resources from permitting the Montana Tunnels Mine were discussed in the 1986 final EIS (DSL 1986).

3.11.1 Analysis Methods

Analysis Area

The analysis area is defined as the geographical area in which the principal direct and indirect socioeconomic effects of Alternative 1 - No Action (L-Pit) and Alternative 2 - Proposed Action Alternative (M-Pit) for the Montana Tunnels Mine are likely to occur.

The study area for population and demographics, housing, and community infrastructure is Jefferson County, Montana. Jefferson and Lewis and Clark counties constitute the study area for economics. Almost 40 percent of the Montana Tunnels Mine employees live in Lewis and Clark County, and most of the employees who live in Jefferson County live in the northern portion of the county, including Montana City and Clancy (**Table 3.11-1**).

TABLE 3.11-1
EMPLOYMENT AT MONTANA TUNNELS, BY COUNTY OF RESIDENCE, 2004

	Jefferson County	Lewis and Clark County	Silver Bow County	Total Employment
Number of Employees	100	85	30	215
Percent of total	46.5	39.5	14.0	100.0

Source: Schaefer 2004

Information Sources

Baseline data for Jefferson County include population and demographic data, current business and economic statistics information for Jefferson and Lewis and Clark counties, and the Montana Tunnels Mine operation in Jefferson City. Information in this section was obtained from the U.S. Census Bureau based on the 2000 census data and the U.S. Bureau of Economic Analysis. More recent data were obtained from the U.S. Census Bureau, the Montana Department of Labor and Industry, the Treasurer of Jefferson County (O'Neil 2004), and John Schaefer at Montana Tunnels. Additional information was obtained from the document "Population, Employment, Earnings, and Personal Income Trends," prepared by the Sonoran Institute for the BLM (2003, 2003a), the Jefferson County Growth Management Plan (2003) and the Lewis and Clark County Growth Policy (2004). In addition, personal communications were used to obtain specific information not otherwise available.

Methods of Analysis

Direct, indirect, and cumulative impacts to socioeconomic resources were assessed based on reviews of similar projects that have occurred in the state and other relevant mining industry policy documents, and through interviews with individuals whose fields of expertise and experience provide insight relevant to this specific project. Conclusions regarding the impacts to local services that may occur during construction, operation, and maintenance of the project were developed by evaluating the number of employees and the duration of these activities relative to the availability of services and amenities that may be required.

3.11.2 Affected Environment

3.11.2.1 Demographics

Table 3.11-2 presents basic population and demographic information for Jefferson County and the State of Montana.

TABLE 3.11-2 POPULATION BY CATEGORY, 1990 & 2000, JEFFERSON COUNTY AND STATE OF MONTANA					
Population by Category	**1990 Population**	**Percent of Total**	**2000 Population**	**Percent of Total**	**Percent Change 1990-2000**
TOTAL POPULATION					
Jefferson County	7,939	100.0	10,049	100.0	26.6
Montana	799,065	100.0	902,195	100.0	12.9
MALE					
Jefferson County	4,029	50.7	5,045	50.2	25.2
Montana	395,769	49.5	449,480	49.8	13.6
FEMALE					
Jefferson County	3,910	49.3	5,004	49.7	28.0
Montana	403,296	50.5	452,715	50.2	12.3
UNDER 20 YEARS					
Jefferson County	2,508	31.6	3,050	30.4	21.6
Montana	244,346	30.2	257,440	28.5	5.3
65 YEARS AND OVER					
Jefferson County	833	10.5	1,035	10.3	24.2
Montana	106,497	13.3	120,949	13.4	13.6

Source: Sonoran Institute 2003

Northern Jefferson County

Jefferson County is one of the fastest growing counties in Montana, growth that is spurred by in-migration of retirees and families focused on the quality of life rather than the need for employment opportunities in the immediate environs. Community life is focused on schools and recreation opportunities.

The Helena Chamber of Commerce estimates that over 50,000 people live in the greater Helena area, including the unincorporated portions of Lewis and Clark County and the northern portion of Jefferson County, which borders the southern edge of the Helena city limits. Jefferson County is growing quickly, especially in the northern part of the county that borders the city of Helena. The latest information from the U.S. Census Bureau is that Jefferson County has a population of 11,256 as of July 1, 2006 up from 10,085 on July 1, 2000.

There are two census designated places in northern Jefferson County that are functionally bedroom suburbs of Helena: Montana City (2000 population of 2,094) and Clancy (2000 population of 1,406). Growth in these two census designated places has been large in the last 10 years; neither of them was even counted in the 1990 census.

The U.S. Census Bureau estimates there are 4,213 housing units in Jefferson County in 2005. Data from Census 2000 show that Jefferson County had 3,747 households, a homeowner vacancy rate of 11 percent and an average of 2.62 persons per household. The home ownership rate was 83 percent. The median housing value was $128,700 and 55 percent of the population had lived in the same house since 1995. None of the communities in the northern portion of the county are incorporated, and the community facilities and services available are provided by special districts or Jefferson County.

Population Projections

Historically, Montana has been one of the slowest growing states in the US. In fact the population is not expected to pass the 1,000,000 mark until 2015, growing at approximately 1 percent per year from the 2000 census numbers. In the 1990s, Jefferson County grew at a rate that was more than twice that of Montana as a whole. In the future, Jefferson County is expected to grow over twice as quickly as the state as a whole, as indicated in **Table 3.11-3**.

TABLE 3.11-3
POPULATION PROJECTIONS FOR JEFFERSON COUNTY AND THE STATE OF MONTANA

Area	2000 Census	2005 Projection	2010 Projection	2015 Projection	Percent change 2000-2015
Jefferson County	10,049	11,230	12,260	13,280	32.2
Montana	902,195	942,580	989,190	1,039,490	15.2

Source: NPA Data Services, Inc. 2004

3.11.2.2 Economy

The study area for economic activities is comprised of Jefferson and Lewis and Clark counties. Together, these counties supported 43,462 full- and part-time jobs in 2000, an increase of 24,283 jobs since 1970. This is an annual average job increase of 4 percent, more than twice the population growth in the study area during the same time frame.

As the capital of Montana and a regional shopping center for residents of Jefferson County, Helena offers a wide range of shops and services. One major shopping mall and several smaller malls are located on the major transportation routes and in the downtown area. The major “box” stores, such as Wal-Mart, Target, Costco, and Home Depot are located in Helena. Nearly 100 restaurants are listed in the local yellow pages, including most national fast food chains and local specialty restaurants.

Lewis and Clark County and Helena have a long record of economic stability due in part to the location of state government in Helena. Federal, state, and local governments account for 24 percent of the employment in Lewis and Clark County, including government offices, the Helena School District, and the Fort Harrison Veteran's Administration hospital. Other major employers include St. Peters Hospital and several other health care facilities; Carroll College, a private Catholic college; the University of Montana College of Technology; various industrial, manufacturing, and commercial businesses; and agricultural operations in the northeast and southeast portions of the Helena valley.

The communities in the northern portion of Jefferson County contain basic retail trade and services activities to support the suburban nature of the area. Residents also use the retail establishments in Helena. A large cement plant is located in the area, as well as recreation-related activities centered on hiking, biking, and camping.

Total employment in 2000 was estimated at 4,608 jobs in Jefferson County. Mining accounted for 7.5 percent of the employment and has seen one of the highest percent growth rates since 1970 (811 percent). As shown in **Table 3.11-4** other fast growing categories under Services and Professional are: services (which includes health, business, legal, engineering, and management services at 23 percent of total employment in 2000) and retail trade (accounting for 15 percent of total employment in the tourism industry).

The Jefferson County Growth Policy (Jefferson County 2003), adopted June 18, 2003, recognizes that the local economy is tied to the region. An objective under the goal of "Sustain and strengthen the economic well being of Jefferson County citizens," states

> "Support economic development activities throughout southwest Montana in recognition of Jefferson County's interdependence with surrounding employment centers and the needs of citizens for goods, services, and other urban amenities available in surrounding communities" (Jefferson County 2003).

According to the Sonoran Institute's Economic Profiling System, as shown in **Table 3.11-5** employment in Lewis and Clark County has grown steadily in the last 30 years (Sonoran Institute 2003a). Mining has been one of the fastest growing categories experiencing 190 percent growth in 30 years. The fastest growing categories under Services and Professional are: services (which includes health, business, legal, engineering, and management services at 32 percent of total employment in 2000), and retail trade which accounts for 17 percent of total employment. The majority of the growth in government employment has been in state and local government.

TABLE 3.11-4
EMPLOYMENT BY INDUSTRY, CHANGES FROM 1970 TO 2000, JEFFERSON COUNTY [a]

Employment Industry	1970	Percent of total	2000	Percent of total	New Employment	Percent Change 1970-2000
Farm and Agricultural Services	**257**	**13.8**	**418**	**9.1**	**161**	**63**
Farm	250	13.4	347	7.5	97	39
Ag. Services [b]	7	0.4	71	1.5	64	914
Mining	**38**	**2.0**	**346**	**7.5**	**308**	**811**
Manufacturing [c]	**22**	**1.2**	**176**	**3.8**	**154**	**700**
Services and professional	**582**	**31.3**	**2,325**	**50.5**	**1,743**	**299**
Transportation and Public Utilities	80	4.3	133	2.9	53	-66
Wholesale Trade	12	0.6	99	2.1	87	725
Retail Trade	205	11.0	686	14.9	481	235
Finance, Insurance, & Real Estate	72	3.9	339	7.4	267	371
Services (Health, Legal, Business, Others	213	11.4	1,068	23.2	855	401
Construction	**58**	**3.1**	**409**	**8.9**	**351**	**605**
Government	905	48.6	934	20.3	29	3
TOTAL EMPLOYMENT	**1,862**	**100**	**4,608**	**100**	**2,746**	**147**

Notes:

[a] – Major sectors are in bold; components of that sector are in regular type

[b] – Agricultural services include soil preparation services, crop services, and other services. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

[c] – Manufacturing includes paper, lumber and wood products manufacturing.

Source: Sonoran Institute 2003

TABLE 3.11-5
EMPLOYMENT BY INDUSTRY, CHANGES FROM 1970 TO 2000, LEWIS AND CLARK COUNTY[a]

Employment Industry	1970	Percent of total	2000	Percent of total	New Employment	Percent Change 1970-2000
Farm and Agricultural Services	**573**	**3.3**	**1,049**	**2.7**	**476**	**83**
Farm	533	3.1	658	1.7	125	23
Ag. Services [b]	40	0.2	391	1.0	351	878
Mining	**30**	**0.2**	**87**	**0.2**	**57**	**190**
Manufacturing [c]	**1,046**	**6.0**	**1,317**	**3.4**	**271**	**26**
Services and professional	**9,423**	**54.4**	**25,012**	**64.4**	**15,589**	**165**
Transportation and Public Utilities	1,135	6.6	1,661	4.3	526	46
Wholesale Trade	376	2.2	1,014	2.6	638	170
Retail Trade	2,500	14.4	6,766	17.4	4,266	171
Finance, Insurance, & Real Estate	1,500	8.7	3,199	8.2	1,699	113
Services (Health, Legal, Business, Others	3,912	22.6	12,372	31.8	8,460	216
Construction	**933**	**5.4**	**2,093**	**5.4**	**1,160**	**124**
Government	**5,312**	**30.7**	**9,296**	**23.9**	**3,984**	**75**
TOTAL EMPLOYMENT	**17,317**	**100.0**	**38,854**	**100.0**	**21,537**	**124**

Notes:
[a] – Major sectors are in bold; components of that sector are in regular type.
[b] – Agricultural services include soil preparation services, crop services, and other services. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.
[c] – Manufacturing includes paper, lumber, and wood products manufacturing.
Source: Sonoran Institute 2003a

TABLE 3.11-6
ANNUAL UNEMPLOYMENT RATES, 2000 – 2003 FOR THE JEFFERSON AND LEWIS AND CLARK COUNTIES AND THE STATE OF MONTANA

Area	2000	2001	2002	2003
Jefferson County	5.4	4.6	4.6	4.7
Lewis & Clark County	4.3	4.4	4.3	3.9
State of Montana	5.0	4.6	4.6	4.7

Source: US Department of Labor 2004

TABLE 3.11-7
INCOME BY TYPE, 2000, JEFFERSON COUNTY (IN MILLIONS OF 2000 DOLLARS)

	2000 Jefferson County	Percent of Total [a]	2000 State of Montana	Percent of Total
Labor Income				
Wage and Salary	60	24	9,987	49
Other Labor Income	9	4	1,308	6
Proprietor's	22	9	2,014	10
Non-Labor Income				
Investment Income	45	18	4,623	23
Transfer Payment Income	31	12	3,275	16

Notes:

[a] – Percentages do not add to 100 because of adjustments made by the Bureau of Economic Analysis, such as residence, social security, and others.

Source: Sonoran Institute 2003

Unemployment in the study area counties and the state has remained consistently low from 2000 to 2003, indicating the relative economic stability in the area (**Table 3.11-6**).

Income

Personal income is defined as all income received by individuals from all sources and include income from work (labor income or earnings), income from non-labor sources such as income from savings and investments (investment income), and income from outside sources such as Social Security or Medicare (transfer payment income).

The source of income in Jefferson County is derived from both labor sources and non-labor sources, as shown in **Table 3.11-7**. The percentages add to only 67 percent, indicating how much of the income of county residents is generated in another county, probably Lewis and Clark County.

According to the Lewis and Clark County Growth Policy (2004) "Lewis and Clark County in general and Helena/East Helena in particular, drive the regional economy (defined as Lewis and Clark, Broadwater, Jefferson, and Meagher counties) and are the source of the majority of jobs and earnings in the area" (pages 11-13). The Demographics and Economics section of the policy notes that "a growing number of people who earn their living in Lewis and Clark County reside outside the County. From 1970 to 2000 the amount of money earned in Lewis and Clark County by non-residents increased from $8 million to $101 million, a 1,200 percent jump." The policy notes that "in 2000, 51 percent of the money earned by Jefferson County residents came from jobs located outside the County."

As shown in **Table 3.11-8** income in Lewis and Clark County is primarily generated by working, principally from wage and salary employment, reflecting the large percentage of the population who work in the services and professional and government sectors.

Per capita income is commonly used to understand the relationship within and outside of county with regard to personal income. While the absolute numbers are the lowest in the study area and are less than the state average, Lewis and Clark County residents have median household incomes above the state average, and those incomes are increasing at a healthy rate based on job growth. Jefferson County has the highest median household income and per capita income in the study area, although that growth is not as robust as in the state or the other counties in the study area. Income growth within Jefferson County does not appear to be directly tied to job growth, probably because of the contribution of non-labor income and the number of county residents who work in Lewis and Clark County.

TABLE 3.11-8
INCOME BY TYPE, 2000, LEWIS AND CLARK COUNTY
(IN MILLIONS OF 2000 DOLLARS)

	2000 Lewis and Clark	Percent of Total [a]	2000 State of Montana	Percent of Total
Labor Income				
Wage and Salary	841	60	9,987	49
Other Labor Income	114	8	1,308	6
Proprietor's	118	8	2,014	10
Non-Labor Income				
Investment Income	304	22	4,623	23
Transfer Payment Income	186	13	3,275	16

Notes:
[a] – Percentages do not add to 100 because of adjustments made by the Bureau of Economic Analysis, such as residence, social security, and others.
Source: Sonoran Institute 2003a

In 2000, Jefferson County median household income was $41,506, higher than Lewis and Clark County and the state (see **Table 3.11-9**).

TABLE 3.11-9
MEDIAN HOUSEHOLD INCOME, 1990 AND 2000, FOR THE JEFFERSON AND LEWIS & CLARK COUNTIES AND THE STATE OF MONTANA

Area	1990 [a]	2000 [b]	Percent Change 1990-2000
Jefferson County	$31,400	$41,506	32.2
Lewis and Clark County	$26,409	$37,360	41.5
State of Montana	$22,988	$33,024	43.7

Sources:
[a] – U.S. Census 1997
[b] – U.S. Census 2000

In 2002, Jefferson County residents had a per capita personal income of $25,696, which was 103 percent of the 2002 Montana average of $24,831 and 83 percent of the 2002 U.S. average of $30,906. In 2002, Jefferson County residents earned a total personal income of about $267 million, which accounted for 1.2 percent of the state total. This was up from about $240 million total personal income for Jefferson County in 1999 (U.S. Bureau of Economic Analysis 2004). The average wage per job in Jefferson County was $27,117 in 2002, which was 105 percent of the 2002 Montana average of $25,790, and 75 percent of the 2002 U.S. average of $36,167 (U.S. Bureau of Economic Analysis 2004a).

Government and Public Finance

In fiscal year 2003, Jefferson County had budgeted expenditures of $6,417,751. Total county-wide assessed valuation was over $526 million with a taxable value of almost $20 million. The taxable value of net and gross proceeds was just over $2.5 million (Ramey 2004). Mill rates vary by area based on school and other special district assessments.

Mining

Mining of all types plays a greater role in Jefferson County's economy than it does for the state (See **Table 3.11-10**).

Jefferson County's largest industries in 2000 were mining (all types), which accounted for 7.5 percent of all employment in 2000 (**Table 3.11-4**) and consisted of 26.6 percent of total earnings by place of work. In Montana, mining accounted for 1.2 percent of all employment in 2002 (U.S. Bureau of Economic Analysis 2004). Jefferson County depends upon mining for 8 to 19 percent of its economy. The Golden Sunlight Mine is the other major metal mining operation in Jefferson County.

TABLE 3.11-10 MINING INCOME IN JEFFERSON COUNTY AND THE STATE OF MONTANA, 2002					
Area	**Mining Earnings**	**Total Non-farm Earnings**	**Mining as a Percent of Non-farm Earnings**	**Total Personal Income**	**Mining as a Percent of Total Personal Income**
Jefferson County	$21.9 million	$114.2 million	19	$267 million	8.2
State of Montana	$451.9 million	$15.6 billion	2.9	$22.6 billion	2.0

Source: U.S. Bureau of Economic Analysis 2004

Montana Tunnels Mining Inc.

Montana Tunnels' operating permit was issued on February 20, 1986. The mine operation has produced lead concentrates, zinc concentrates and gold-silver bullion. The concentrates contain gold and silver values as well. Revenue has been derived primarily from gold sales, but zinc is occasionally the primary revenue generator depending upon fluctuations in monthly price and production levels (Montana Tunnels 2007). The prices of all four metals are currently near all-time highs (Kitcometals 2007 and Kitco 2007) as world demand for them steadily increases.

The ore extracted from the Montana Tunnels Mine is all processed in the Montana Tunnels milling facility to produce metal bearing concentrates that are sold to smelters and refiners who reduce the concentrates to primary metals. These primary metals are eventually put to commercial use in a variety of industries.

Montana Tunnels functions as a "basic industry" in the State of Montana and the Jefferson County economy. Basic industries are those business and government activities that bring outside income into an area economy. By paying salaries and making purchases with non-local monies into area economies, Montana Tunnels provides a foundation for state, regional and local county economic development by direct employment, purchases of goods and services, and taxes and royalties, as described below.

Direct employment

Montana Tunnels' operations were continuous for more than 18 years until a temporary shut-down in late 2005 due to L-Pit highwall failures in the area of the mine access ramp. At that time, a majority of the mining department was laid off. Mining resumed in September 2006, and during the next months, employment was ramped up to meet production needs. Employment in 2007 is at 201 personnel with most areas of the operation staffed to budgeted levels. About two-thirds of employees were working at the mine when it shut down in 2005 (Schaefer 2007).

Montana Tunnels has historically been the largest private employer in Jefferson County with an average of about 215 employees in 2004. The word 'average' is used because the total number of employees at Montana Tunnels fluctuates during any given year, based upon the amount of work that needs to be done. A small number of these employees were part-time workers. Taking into account the part time jobs, there were about 200 full time job equivalents at the mine in 2004. Of the total 215 employees at Montana Tunnels in 2004, about 100 lived in Jefferson County, where the mine is located, about 85 lived in Lewis and Clark County and about 30 lived in Silver Bow County. In January 2005, there were 4,894 persons employed in Jefferson County. The unemployment rate was 5.2 percent (Montana Department of Labor and Industry 2005). This indicates that Montana Tunnels' approximately 100 in-county workers made up about 2.1 percent of all working employees in Jefferson County in 2004.

In 2004, Montana Tunnels provided its workers approximately $8.25 million in annual total wages and $2.3 million in annual total benefits. The annual total income earned by Montana Tunnels' 100 Jefferson County workers, estimated at about $3.7 million (45 percent of the total $8.25 million figure) was about 1.4 percent of 2002 total personal income in Jefferson County and about 3.2 percent of total non-farm earnings in Jefferson County in 2002. The $3.7 million amount earned by Montana Tunnels' in-county workers represented about 17 percent of all earnings from mining in the county, which totaled just under $22 million in 2002. Montana Tunnels' Lewis and Clark and Silver Bow County workers made up a small portion of their respective county's total work force and total earnings (less than 1 percent in each case).

Montana Tunnels employees earned an annual average wage of $40,800 in 2004. In the period between July 2003 and June 2004, the average wage for all types of mining in Jefferson County was $49,836 (Montana Department of Labor and Industry 2005). The Montana Tunnels employee benefit package averages an additional 32 percent of wages paid or about $13,000 annually per worker. This benefit level is likely better than the average for other Jefferson County workers and is believed to be better than the average for all Montana workers. Montana Tunnels' employees earn more income and benefits than they would making the average wage in Jefferson County which was $27,117 in 2002 (Schaefer 2004).

Purchases of goods and services

Montana Tunnels, at historic full operation, spent between $17 and $25 million annually in Montana for equipment, materials and services to operate the mine. Recently, Montana Tunnels has been in an expansion mode using more equipment and materials such as fuel, equipment, parts and services to strip waste rock from the upper areas of the mine. In 2004, 287 Montana vendors were paid approximately $25 million by Montana Tunnels (Schaefer 2004).

Taxes and Royalties
Montana Tunnels has, at historic full operation, been the largest taxpayer in Jefferson County. According to Montana Tunnels, it generated $1,180,000 annually in total taxes on average from 1999 to 2003. Montana Tunnels employees also pay state income taxes from their income earned at the mine (Schaefer 2004). In 2003, there were only two other taxpayers within the county that generated more than $500,000 in total taxes, and both generated less than $1 million (O'Neill 2004). Golden Sunlight Mine is also an important taxpayer in the county.

During the 5-year period between 1999 and 2003, about $320,000 of Montana Tunnels' $1.18 million in total taxes was paid out annually in property taxes. The taxes charged to Montana Tunnels by Jefferson County in 2003 comprised 6 percent of the total $8.88 million real property tax charge to all of Jefferson County, and 7 percent of the $9.99 million total real property tax charge in 2004 (O'Neill 2004). In this same time period, Montana Tunnels contributed between 29 percent and 33 percent of the total tax funding received by the Clancy Elementary School District and an average of 10 percent of the total received by the Boulder High School District (O'Neill 2004).

Between 1999 and 2003, Montana Tunnels paid an average of $524,000 annually for the Metalliferous Mines License Tax and an average of $335,000 annually for the Metal Mines Gross Proceeds Taxes. Of the $1.18 million paid out in average annual taxes by Montana Tunnels from 1999 to 2003, about $505,000 on average was allocated to the Montana general fund and about $580,000 annually was allocated to local government in Jefferson County. Another $94,000 annually was allocated to various special accounts as designated by the Metal Mines Gross Proceeds Tax. Of the $580,000 allocated to local government each year, about $185,000 was allocated to local school districts, about $47,000 was allocated to the County Hard Rock Fund and the remaining $350,000 was allocated to county government. These amounts were estimated using the existing mills for Jefferson County during those years and assuming that all tax revenues were allocated as they should have been according to Montana Code.

3.11.3 Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The purpose of the order is to avoid the disproportionate placement of adverse environmental, economic, social, or health effects from federal actions and policies on minority and low-income populations.

The first step in analyzing this issue is to identify minority and low-income populations that might be affected by implementation of the Proposed Action or alternatives. Demographic information on ethnicity, race, and economic status is provided in this section as the baseline against which potential effects can be identified and analyzed.

The Council on Environmental Quality identifies these groups as environmental justice populations when either (1) the minority or low-income population of the affected area exceeds 50 percent or (2) the minority or low-income population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis. In order to be classified meaningfully greater, a formula describing the environmental justice threshold as being 10 percent above the State of Montana rate is applied to local minority and low-income rates.

Identification of Minority and Low Income Populations

For purposes of this section, minority and low-income populations are defined as follows:

- *Minority populations* are persons of Hispanic or Latino origin of any race, Blacks or African Americans, American Indians or Alaska Natives, Asians, and Native Hawaiian and other Pacific Islanders.

- *Low-income populations* are persons living below the poverty level. In 2000, the poverty weighted average threshold for a family of four was $17,603 and $8,794 for an unrelated individual.

Estimates of these two populations were then developed to determine if environmental justice populations exist in Jefferson County (**Table 3.11-11**).

TABLE 3.11-11
MINORITY POPULATIONS AND LOW-INCOME POPULATIONS, JEFFERSON COUNTY, 2000

Location	Total Population	Percent Minority	Percent below poverty (1999)
Jefferson County	10,049	4.8	9.0
State of Montana	902,195	10.5	14.6

Source: US Census 2001

Approximately 95 percent of the population in Jefferson County is White, not of Hispanic or Latino origin; 0.1 percent are Blacks or African Americans; 1.3 percent are American Indians and Alaska Natives; 0.4 percent are Asians; and 0.1 percent are Native Hawaiian and other Pacific Islanders. People of Hispanic or Latino descent, of any race, account for 1.5 percent of the population. There are no designated American Indian Reservations in Jefferson County (**Table 3.11-12**).

Minority and low-income populations were lower in Jefferson County than for the State of Montana. No environmental justice populations exist, and no analysis of impacts is necessary.

TABLE 3.11-12
POPULATION BY RACE
JEFFERSON COUNTY AND THE STATE OF MONTANA, 2000

Race	County	Percent of Total	State	Percent of Total
White	9,654	96.1	817,229	90.6
Black or African American	14	0.1	2,692	0.3
American Indian or Alaska Native	127	1.3	56,068	6.2
Asian	42	0.4	4,691	0.5
Native Hawaiian & Other Pacific Islander	7	0.1	470	0.1
Some other race	38	0.4	5,315	0.6
Two or more races	167	1.7	15,730	1.7
Hispanic or Latino (of any race)	151	1.5	18,081	2.0
White persons not of Hispanic or Latino	9,564	95.2	884,114	2.0

Source: Sonoran Institute 2003

Public Involvement and Environmental Justice

NEPA guidance encourages an environmental justice scan prior to public scoping of the proposed project to ensure that minority and low-income populations are included in the range of public involvement activities. Public involvement meets two requirements of Executive Order 12898:

- It aids in identifying minority and low-income groups, and
- It provides the means for these groups to participate in federal decision making that might affect them.

A full description of the EIS public involvement process is located in Section 1.6.

Protection of Children

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), recognizes a growing body of scientific knowledge that demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because

- Children's bodily systems are not fully developed,

- Children eat, drink, and breathe more in proportion to their body weight,
- Their size and weight may diminish protection from standard safety features, and
- Their behavior patterns may make them more susceptible to accidents.

Based on these factors, the President directed each federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. The President also directed each federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Children are infrequently present at the Montana Tunnels Mine as occasional visitors. On such occasions, the Montana Tunnels staff has taken and would continue to take precautions for their safety using a number of means, including fencing, limitations on access to certain areas, and provision of adult supervision. No impact analysis is required.

3.11.4 Environmental Consequences

Alternative 2 – Proposed Action Alternative (M-Pit) and Alternative 3 - Agency Modified Alternative would both extend the level of economic activity in Jefferson County associated with full operation of the mine 4.5 years beyond what would occur under Alternative 1. The full operation level of economic activity would continue through 2013 under Alternatives 2 and 3 as opposed to through 2009 under Alternative 1. Salaries paid by Montana Tunnels would continue to be higher on average than other employment in the county and in the state. Tax revenues and mineral royalties from the mine would continue at their 2004 full operation levels or higher, depending on the price of minerals and on local mill levies that fund local and state government operations.

3.11.4.1 Alternative 1 – No Action Alternative (L-Pit)

For Alternative 1, the mine expansion amendment would not be permitted and Montana Tunnels would continue to operate as permitted under the L-Pit Plan.

The social changes to Jefferson County would include the long-term adverse impact of the loss of approximately 80 full time jobs within Jefferson County (out of 180 total full time jobs lost within all of Montana) in 2009 as opposed to the loss of those jobs in 2013 for Alternative 2. These jobs have been held by county residents for the past 20 years (with the exception of a 1 year period in 2005-2006) during which time families of the miners have grown up in the county, gone to school, and been active members of the community. Besides the potential economic impacts, local residents would be adversely impacted if their friends and neighbors are out of work, possibly having to leave the

area for new employment. This same impact would take place for Alternative 2, but about 4.5 years later in time.

At the time of closure in 2009 under Alternative 1, about 180 full-time employees would be laid off from Montana Tunnels and their incomes terminated. Another 15 to 25 part time employees would also be laid off. When the mine is shut down, mine site care, maintenance and closure would require about 10 to 20 employees to maintain the facilities for the duration of the shut down period. Perhaps 10 of these employees would reside in Jefferson County. Otherwise operations and employment would remain shut down (Schaefer 2004).

For Alternative 1, Jefferson County residents would be adversely impacted in the long term at a personal level by loss of wages, and county government would be impacted by the loss of royalty and tax income. About 80 of the 180 employees laid-off under Alternative 1 would reside in Jefferson County, representing about 1.6 percent of the total jobs in the county and a loss of $3.4 million in annual wage income for Montana Tunnels workers that reside in Jefferson County. This $3.4 million annual loss in income would be about 1.3 percent of 2002 total personal income in Jefferson County and about 3.0 percent of total non-farm earnings in Jefferson County in 2002. This impact would be exacerbated because of the exceptional value of good paying jobs in Montana and the heavy reliance by the county on Montana Tunnels as a large employer and taxpayer. The rest of those laid off would reside in Lewis and Clark, and Silver Bow counties. Immediately following the shutdown, unemployment levels would be higher in all three counties (although almost undetectable in Lewis and Clark and Silver Bow counties). Eventually, those levels would go back to normal levels as laid off workers either leave the area or find other jobs. Workers would no longer pay income taxes from Montana Tunnels-generated income to the state.

Alternative 1 would adversely impact local tax revenue for Jefferson County in the long term, in particular the revenues earmarked for the Clancy Elementary School District and the Boulder High School District. Montana Tunnels accounts for about 10 percent of total real property tax charged to all of Jefferson County and accounts for at least 20 percent of all tax-related financing for the two school districts in the county.

Montana Tunnels would no longer pay its tax share to Jefferson County, to the State of Montana or to the federal government, except for a small portion of Montana property tax during final mine reclamation after 2013.

Under Alternative 1, Jefferson County would receive about $0.48 million less in annual local tax revenue than the average that has been paid to the county by Montana Tunnels from 1999-2003 (the $.48 million annual payments will end after 2009). This amount takes into account that about $150,000 would still be paid annually in property taxes under Alternative 1, with about $100,000 of that going to county funds. Using 1999-

2003 average figures, the total amount of taxes that would not be paid to Jefferson County if the Proposed Action M-Pit Plan were not approved, would be $2.16 million. About $.6 million annually that has been paid to the State General Fund would not be realized, with a total reduction in revenue to the county and state of potentially $5.31 million, compared with the Proposed Action.

The average annual tax Montana Tunnels paid in 1999-2003 was just over $1 million. Under Alternative 1, Jefferson County would not receive an additional $1.06 million in tax revenue projected under Alternative 2 (see Section 3.11.4.2 below). Over 4.5 years this would amount to $4.77 million lost for the county and $9.36 million lost in county and state taxes combined, compared with Alternative 2 (see discussion of projected taxes below). Local businesses and businesses that directly supply the mine would lose Montana Tunnels-related business.

Under Alternative 1 the county burden to provide public services for mine related activities would be reduced. Potential environmental damage associated with the 4.5 additional years of mining would be avoided. The largest environmental damage that would be avoided under Alternative 1 would be the rerouting of Clancy Creek and Pen Yan Creek. While those two creeks would avoid substantial alterations under Alternative 1, neither creek provides much economic contribution to the area.

3.11.4.2 Alternative 2 – Proposed Action Alternative (M-Pit)

The primary socioeconomic impacts for Alternative 2 would be mostly in the form of continuing the social stability, employment and income, and tax revenues in Jefferson County. These impacts would be short term and beneficial. After mine closure in 2013, the long-term adverse impacts would be similar to those described under Alternative 1.

The M-Pit Mine Expansion would employ about 180 full-time Montana Tunnels employees for an estimated 4.5 years beyond Alternative 1. This number could fluctuate between 150 and 260 over this time period with an average of 215 total workers from 2009-2013 during the expansion. Some of the additional workers above the 180 full-time number would likely be temporary hires (Schaefer 2004) who would work on average a half-time schedule (20 hours per week). There would be about 200 full-time equivalents employed from 2009-2013 over 4.5 years under Alternative 2. In 2013, under Alternative 2, most of those jobs would be terminated.

Workers would remain employed over the duration of the 4.5 years with an average income of $40,800 per year (Montana Tunnels 2007). Using the average Jefferson County annual job income of $27,117 (rounded to $27,100 which is $13,700 less than the average Montana Tunnels wage) as a baseline, M-Pit Mine Expansion would lead to an external benefit from higher wages of about $2.47 million annually (180 workers X $13,700 in higher income each). In other words, the 180 full-time workers would make

about $2.47 million more total in wages per year than they would make earning the average wage in Jefferson County. Benefits from higher wages for part-time workers are not calculated. A portion of this $2.47 million annual amount in greater wages would go towards local, state and federal income taxes. This amount assumes that, without the M-Pit Mine Expansion, Montana Tunnels workers within a short period of time would find other jobs earning the county average wage. Over 4.5 years, this additional wage benefit figure becomes $11.1 million for the life of the amendment. This number does not include any additional employee benefits from the expansion over the case without the expansion. The economic benefits from additional employee work-related benefits are not calculated because the average work-related benefits for Jefferson County employees are not known.

Montana Tunnels would pay out an average annual income of $9.7 million to its workers, which would become $12.8 million annually if benefits are included. Over 4.5 years, the total income paid out would total $43.6 million and with benefits, about $56.7 million. The $11.1 million figure plus better than average benefits is the appropriate figure to use for societal benefits of the proposed mine from higher wages over 4.5 years.

As a result Alternative 2, Jefferson County would receive continued tax revenue benefits from an estimated 4.5 additional years of Montana Tunnels-generated tax revenue. From a local viewpoint, the tax revenue from Montana Tunnels directly benefits Jefferson County in terms of funding local government, countywide education and local projects like road improvements. Montana Tunnels estimates that they would pay about $2.08 million annually in total taxes under Alternative 2 or $9.36 million in total tax payments over the extended life of mine. This annual average, according to Montana Tunnels, would break down to Montana Tunnels paying about $530,000 annually in property taxes, $671,000 annually for the Metal Mines Gross Proceeds Tax, and $880,000 annually for the Metalliferous Mines License Tax (Schaefer, John 2004). DEQ believes these numbers may be optimistic but reliable. The property taxes and the Metal Mines Gross Proceeds Tax would be distributed according to Jefferson County Mill levies[1]. The distribution of the Metalliferous Mines License Tax is more complicated, with much of it going to the State General Fund and various state mining accounts[2].

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1 *The Metal Mines Gross Proceeds Tax is class 1 of the property tax and is collected by the county, presumably being distributed according to local mill distributions (Fogle 2004).*

2 *The current distribution of the Metal Mines License Tax is 58 percent to the State General Fund, 8.5 percent in the Hard-Rock Mining Reclamation Account; 7 percent in the Reclamation and Development Grants Account; 2.5 percent in the Hard-Rock Mining Impact Trust Account; and 24 percent to the county or counties identified as experiencing fiscal and economic impacts under an impact plan. If no such plan has been prepared, that same 24 percent goes instead to the county in which the mine is located (15-37-117, MCA). Of the 24 percent to counties, at least 37.5 percent of that goes to the county Hard Rock Mining Impact Trust Account and the rest is split evenly between county planning and economic development, elementary schools, and high schools (Fogle 2004).*

Assuming that Montana Tunnels pays $2.08 million per year in total taxes under Alternative 2, about $3.5 million total would go to the State General Fund over the 4.5 year period. The 4.5 year period would add an estimated $4.77 million total of local tax revenue to Jefferson County over Alternative 1. Of this total amount over 4.5 years, about $3.15 million would go to local school districts and the remaining $1.62 million to county government (including a small amount for miscellaneous local levies) assuming distribution according to the current Jefferson County mill distribution.[3] Assuming that past tax revenue trends continue for Jefferson County, this amount would represent 10 to 15 percent of total real property tax collected annually for the entire county (often $8 to $10 million total) and even higher percentages for the total funding of the school districts. With metal prices as high as they currently are, tax revenue generated by the Montana Tunnels Mine could be higher than the estimated amounts in this section. It also could be lower if either metal prices drop or if less metals are mined overall.

Alternative 2 would have little effect upon total tax revenues for the State of Montana. The State of Montana would receive tax revenue from Montana Tunnels in the form of the state mills from property taxes, the Metal Mines License Tax and corporation taxes. Out of the $2.08 million in estimated annual taxes, it is expected that about $780,000 would go annually to the State General Fund or about $3.5 million over 4.5 years. It is expected that about $160,000 annually would go to state mining accounts including the Hard-Rock Mining Reclamation Account, the Reclamation and Development Grants Account, and the Hard-Rock Mining Impact Trust Account. This would amount to $720,000 to state mining accounts over 4.5 years. About $80,000 annually would go to the County Hard Rock Mine Account, which is also a state fund. Although the corporation tax amount is confidential, it can be said with confidence that the total Montana Tunnels-generated tax revenue that goes to the state is small compared to total revenues collected and kept by Montana as a whole (greater than $1 billion per year).

Some businesses in Jefferson and Lewis and Clark counties and in other areas in Montana would benefit from Montana Tunnels purchases of their goods and services. Assuming an average of $25 million in Montana Tunnels purchases from Montana businesses, the approximate amount that Montana vendors were paid by Montana Tunnels in 2004, total secondary benefits to Montana would total about $113 million from Montana Tunnels purchases over 4.5 years (Schaefer 2004). On a state level, this

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[3] *The average mill distribution used in this report for Jefferson County reflects 2004 mill levies for the average county resident. For simplification, city mills from Boulder and Whitehall were not included and all county residents were assumed to pay the average county levy, even though mill levies differ across county residents. Information on mill distributions was obtained from the Biennial Report 2002-2004, Montana Department of Revenue. Information was also obtained from Patty O'Neil, Treasurer of Jefferson County. It is assumed that the property tax collected on Montana Tunnels is divided out in Jefferson County for the average taxpayer in that county in tax year 2004 at: 101 mills for the State General Fund, 105.98 mills for Jefferson County, 185.24 for local schools, 44.32 for countywide schools, and 14.04 for miscellaneous levies for an average county levy of 450.58 mills. Those who live in Boulder and Whitehall pay an average of 565.77 mills, but for simplicity, the 450.58 number is assumed for all county residents.*

money is not counted as a direct benefit, but instead as a transfer of money from one business to another. From an individual business perspective, however, these purchases would likely be important and beneficial to those Montana businesses that heavily rely on Montana Tunnels purchases.

Indirect beneficial economic impacts would also accrue from the additional 4.5 years of jobs and higher income under Alternative 2. For example, local businesses in Jefferson and Lewis and Clark counties would benefit indirectly from additional business as a result of purchases by Montana Tunnels employees and their families that might not otherwise live in the area or have as much income without the mining jobs. Retail business such as restaurants/bars, gas stations, and stores and services such as medical, mortgage, and insurance would all benefit to some extent.

All of the metals produced from the Montana Tunnels Mine have applications in manufacturing products such as automobiles, alloys, jewelry, or other products. Because these metals are mined in great quantities worldwide, the additional amount of ore from the proposed Montana Tunnels expansion would not have a major effect on world prices or world supply. Montana Tunnels' production for each of its produced metals is a small percentage of world production.

On a national and world level, the main impact of extending mine operations an additional 4.5 years over Alternative 1 would be from human use of the additional metals extracted as a result of the M-Pit Mine Expansion[4]. Current world supply and pricing for these metals show zinc and lead near record high prices. The prices for zinc and lead are currently several times higher than prices in the early part of this decade (Kitcometals 2007). The values of gold and silver, which vary more with changes in world currency, economic conditions, and political sensitivities, are at the upper ranges of their recent price trends and near historic highs. Rapid economic development in foreign countries such as China and India is currently causing greater demand for all metals produced by Montana Tunnels. Clearly, the metals that would be mined as a result of the expansion are in demand by the U.S. and world economy.

Montana Tunnels would potentially benefit from the M-Pit Mine Expansion by possibly making additional profit for 4.5 years beyond Alternative 1. Any profit made would benefit owners of the company and share holders. The amount of profit that would be made is unknown and not of concern for this EIS. Those owners and shareholders who live in Montana who benefit from Alternative 2 in terms of increased profit would constitute a benefit for Montana. The higher the world prices for all of Montana Tunnels' metals, the greater the chance of company profit under Alternative 2.

[4] *The official economic benefit of these metals would be the consumer surplus created by all the metals extracted as a result of the M-Pit Mine Expansion. For a given person, consumer surplus is the difference between the price of the metal and the actual value of the metal to the consumer.*

Jefferson County currently provides few local services to Montana Tunnels for the mine. The county maintains the county road between Jefferson City and the Montana Tunnels access road and provides some refuse service. No new services over the current ones provided would be required of Jefferson County as a result of Alternative 2 (Montana Tunnels 2007). There would be continued levels of road traffic from mining vehicles over 4.5 additional years of mining.

Economic and social impacts of Alternative 2 include any economic costs (*e.g.*, environmental damage and public nuisance) that would result from the M-Pit Mine Expansion including the years after the mine shuts down. Few residences are located near the mine at the current time, so additional residential nuisance over the extended mine operation would be kept to a minimum. The main environmental effects under Alternative 2 include (1) increasing the permitted area and depth of the mine pit, (2) expanding waste rock storage areas, (3) raising the tailings storage facility embankment for additional tailings storage, (4) providing staging areas for soil and gravel, (5) diverting the courses of two stream channels, (6) re-routing a portion of the mine access road around the tailings pond, (7) increasing the operating permit boundary, and (8) routing surface flows from Clancy Creek into the M-Pit.

Most economic costs from environmental impacts from the mine, including the visual effects and ecological footprint left behind, have likely already resulted from past operation. Alternative 2 would disturb another 252 acres, not greatly expanding the land acreage disturbed in the local area, but involving continued mining on the sides of the existing pit and raising the height of an existing tailings storage facility embankment (Montana Tunnels 2007).

Two streams would have their channels realigned, and new storage areas would be created for soil and gravel. Little recreation currently occurs right next to the mine in the areas that would be expanded. Thus, little economic cost is expected on recreation in the area.

3.11.4.3 Alternative 3 - Agency Modified Alternative

The economic impacts for Alternative 3 would be the same as for Alternative 2.

3.12 Cultural Resources

3.12.1 Analysis Methods

The affected environment for cultural resources was discussed in the 1986 final EIS on page III-95. The impacts to cultural resources from permitting the original Montana Tunnels project were discussed in the 1986 final EIS on page IV-66.

Analysis Area

The analysis area for cultural resources includes the 185 acres included in the proposed M-Pit operating permit boundary expansion area.

Information Sources

Information for the analysis of cultural resource issues at the Montana Tunnel mine was derived from several cultural resources specialist reports, as well as cultural resource inventory forms for specific sites. The report entitled *A Class III Cultural Resources Inventory of the Apollo Gold /Montana Tunnels Proposed Permit Expansion Area, Jefferson County, Montana* (Ferguson 2003) is part of the amendment application.

Methods of Analysis

For purposes of this analysis, cultural resources include buildings, structures, sites, objects, and districts, as defined in Section 301(5) of the National Historic Preservation Act:

> **Building –** a resource created principally to shelter any form of human activity, such as a house.
>
> **Structure** – a resource created for purposes other than creating human shelter, such as a bridge, tunnel, roadway or system of roads, canal, and railroad grade.
>
> **Site** – the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the *location itself* possesses historic, cultural, or archeological value regardless of the value of any existing structure. Examples include: villages, battlegrounds, cemeteries, and natural features that have cultural significance.
>
> **Objects** – a construction that is distinguished from buildings and structures as primarily artistic in nature or relatively small in scale and simply constructed. Although it may be movable, an object is associated with a specific setting or

environment. Some examples include: sculpture, monuments, boundary markers, statuary, and fountains.

District - a district possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development. Examples include: college campuses; central business districts; residential areas; commercial areas; and industrial complexes—including historic mines and mining districts.

In anticipation of the planned M-Pit Mine Expansion, Montana Tunnels contracted with GCM Services to conduct an intensive cultural resource inventory of the proposed M-Pit Plan expansion area, an irregularly shaped parcel of land in Township 7 North Range 4 West, containing 185 acres. The inventory resulted in the relocation of one previously recorded property (an old miner's camp and the identification and recordation of four previously undocumented historic-era properties including: a discovery tunnel, a homestead, an old mine, and a trash dump believed to be associated with another mine in the area (Ferguson 2003).

For purposes of assessing the environmental consequences, it is usually the case that only "historic resources," that is,, properties determined "eligible" for, or listed in, the National Register of Historic Places (National Register) are considered. Cultural resources that have been documented and evaluated and determined "not eligible" for listing in the National Register are generally eliminated from the assessment of effect.

Impact to historic properties is determined by applying the criteria of "adverse effect" as outlined in Section 106 of the National Historic Preservation Act. Generally speaking, any undertaking that negatively impacts any of the seven aspects of historical integrity (materials, workmanship, design, location, setting, feeling, and association) of an "eligible" property would constitute an "adverse effect." Ground-disturbing activities that directly impact historic properties, as well as visual and/or auditory intrusions, all have the potential to produce adverse effects, depending upon the character of significance of the historic property.

3.12.2 Affected Environment

Background Information

The Montana Tunnels Mine is located within the Colorado Historic Mining District (a.k.a., Colorado/Wickes Historic District).[5] Located roughly 20 miles south of Helena, the district is described as embracing the Spring Creek drainage, extending southward from Quartz Creek and the headwaters of Clancy Creek to the headwaters of Spring

[5] *The Smithsonian number assigned to the historic district is 24JF747.*

Creek and the Great Northern Railway tunnel (http://www.deq.mt.gov/AbandonedMines/linkdocs/techdocs/78tech.asp).

Mining began in the district in 1864, beginning with the exploitation of placer gold deposits and proceeding to lode mining a short time thereafter. Ores in the district produced silver, lead, gold, copper, and zinc. With regard to the historical period, mining continued in the district until roughly 1960. Open pit mining at the Montana Tunnels Project, initiated in 1987, represents the most extensive modern mining venture within the historic district.

In the 1980s, the area in the vicinity of the community of Wickes was documented as a historic mining district and recommended "eligible" for listing in the National Register under criteria A and C, with a period of significance from 1867 (the date of construction of the first smelter at the small community of Gregory) through 1907 (the end of the copper boom). In 1996, the Keeper of the National Register found that the district retained insufficient integrity to be "eligible" for listing under Criteria A, B, or C. This finding was based largely upon the impacts associated with the modern open pit mine, which had destroyed a large part of the historic mine workings in the center of the district. The Keeper did not render an opinion about the eligibility of the property under Criterion D (its information potential), citing a lack of pertinent information (Ferguson 2003).

Individual mines within the Colorado Historic Mining District have been determined "eligible." One of these is the Mount Washington Mine, originally recorded in 1981. GCM Services, Inc. reevaluated the mine in 1997, recommending that it be considered "eligible" for listing under National Register Criterion A (for its association with historically significant events) and Criterion D (for its potential to yield important information regarding the mining process).[6]

Inventory Results Specific to the Proposed M-Pit Mine Expansion

The previously recorded property located within the proposed M-Pit Plan expansion area is the miner's camp. Recorded in 1984 as part of the original cultural resources documentation for the Montana Tunnels Project, this property was recommended "not eligible" for listing in the National Register (Anderson and Fredlund 1984).

The discovery tunnel contains a collapsed adit and an associated waste rock storage area. The 20-foot-high pile extends from the adit to the west edge of the Clancy Creek Road—a distance of roughly 200 feet. Both features are located within the boundary of

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[6] *Reclamation of the Mount Washington Mine is currently underway. The project is sponsored by the Montana Department of Environmental Quality's Abandoned Mine Reclamation Program. It is scheduled to be completed by July 2007 (Caywood 2007).*

a mining claim, located in 1909. This claim is one of many included in Mineral Survey 8940 (totaling 423 acres), surveyed on August 9, 1909. GCM Services recommended that this property be determined “not eligible” for listing on the National Register because it failed to meet any of the four criteria for eligibility (Ferguson 2003:21).

The homestead consists of three depressions, believed to represent the remains of buildings, a root cellar, a short segment of ditch, and an artifact scatter on the west side of Clancy Creek. These remains are located within a 68-acre homestead claim patented in 1919. GCM Services recommended that this property failed to meet any of the four National Register eligibility criteria and that it be determined “not eligible” for listing in the National Register (Ferguson 2003:19).

The mine consists of a series of collapsed entries (adits) and associated waste rock piles, a number of buildings in various states of repair (including a shop and two privies), and a trash dump containing mostly cans. These resources are located on the north side of Pen Yan Creek, northeast from the principal features of the Mount Washington Mine (Ferguson 2003:12-13). GCM Services recommended that the mine be determined “eligible” for listing in the National Register under criteria A and D, as a component of the Mount Washington Mine. The period of significance is between 1914 and 1945 (Ferguson 2003:13-14).

The trash dump consists of an "indistinct depression" in association with a scatter of artifacts, which appear to date from the 1860s through the 1880s—the period during which the adjacent Minah Mine was operating as a major producer in the Colorado Historic Mining District. The depression and associated artifact scatter are located outside the boundary of the Minah Mine proper, which was recorded as site. The Montana Tunnels L-Pit has destroyed all of the features associated with the Minah Mine proper, leaving only this trash scatter. GCM Services recommended that the trash dump failed to meet any of the four National Register eligibility criteria and that it be determined “not eligible” for listing in the National Register (Ferguson 2003:16-17).

3.12.3 Environmental Consequences

Although it is usually the case that only National Register-eligible properties are considered in the environmental consequences analysis, compliance review of the 2003 GCM Services report has not been completed, and there is no formal consensus determination of eligibility for the properties documented in that report. Because of this, each of the five properties located within the proposed permit expansion area is treated as potentially “eligible” for listing in the environmental consequences for the two action alternatives.

3.12.3.1 Alternative 1 – No Action Alternative (L-Pit)

Under this alternative, the mine would continue to operate within the L-Pit operating permit boundary. Eight previously documented historical mining sites have already been recorded and mitigated through photographic documentation (Montana Tunnels 2007). There would be no additional effect to cultural resources.

3.12.3.2 Alternative 2 – Proposed Action Alternative (M-Pit)

Consequences to the five newly recorded cultural resource properties located within the proposed permit expansion area associated with Alternative 2 are discussed below. Both physical and visual effects are discussed. Potential adverse effect from atmospheric impact (noise) is not considered as the properties are not susceptible to auditory impacts.

Miners Camp

The miner's camp is located within the bottom of the Clancy Creek drainage. This site no longer retains enough charateristics to fit the definition of "site." It would not be affected by mine operations.

The Discovery Tunnel

The features associated with the discovery tunnel occupy the base of a steep hill slope above the east bank of Clancy Creek. Although located within the proposed M-Pit Mine Expansion area, the discovery tunnel would not be physically impacted by the expansion of the M-Pit or by the proposed diversion of Clancy Creek. This site has been determinted "not eligible" and would not be affected by mine operations.

The Homestead

This property is located adjacent to the east bank of Clancy Creek. The five features associated with the site (four depressions and a segment of ditch) would be destroyed by the proposed diversion of Clancy Creek. This site has been determined "not eligible" and would not be effected by mine operations.

The Old Mine

This property is located adjacent to the south edge of the proposed contingency waste rock storage area. The features associated with the site (including an adit and associated waste rock pile, and several standing buildings) would not be physically impacted by the contingency waste rock storage area. In the event that the waste rock

storage area is used, its presence could impact the integrity of setting of the old mine and alter its relationship to the Washington Mine, with which it is historically associated. This site has been determined “eligible” and would be avoided by mine operations. If avoidance is not possible, an MOU would be developed between Montana Tunnels, the BLM, and the Montana State Historic Preservation Office to mitigate impacts.

The Trash Dump

The trash dump is located on a steep hill slope just south of the existing L-Pit mine. Its location is within the footprint of the proposed contingency waste rock storage area, and the site would be covered by modern mining waste if the area is used. This site has been determined “not eligible” and would not be affected by mine operations.

3.12.3.3 Alternative 3 – Agency Modified Alternative

The consequences to cultural resources for Alternative 3 would be the same as for Alternative 2. The agencies would require the development of an MOU between Montana Tunnels, BLM, and the Montana State Historic Preservation Office to mitigate impacts.

3.12.4 Native American Consultation

Consultation with Native American tribal governments is ongoing, and would include at a minimum: the Confederated Salish and Kootenai Tribes of the Flathead Reservation, the Blackfeet Nation, Shoshone-Bannock Tribes of the Ft. Hall Reservation, and the Chippewa-Cree Nations of the Rocky Boy Reservation. Other tribal governments may be solicited for their comments, if the situation warrants it. To date, no Native American concerns have been identified in the new disturbance area under any of the alternatives through consultation by BLM (Kiely 2007).

Cumulative, Unavoidable, Irreversible and Irretrievable, and Secondary Impacts

4.1 Cumulative Adverse Impacts

Cumulative effects are the impacts on the environment that result from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Under MEPA, only those actions under concurrent consideration by any agency need be analyzed as future actions. Analysis of cumulative environmental effects of a proposed action includes other actions that are related to the proposed action by location or generic type, recognizing that effects on recreation, transportation, air quality, noise, biological resources, socioeconomics, water, and other resources might be manifested beyond the project site.

The geographical extent of the study area was selected for each resource evaluated in this EIS based on the extent and duration of anticipated effects caused by the Proposed Action. The cumulative effects region of influence includes all areas in which planned or expected actions might affect one or more the study areas listed below.

Resource	Study Area
Geology and Minerals:	Permit boundary
Geotechnical Engineering:	Permit boundary
Soil, Vegetation, and Reclamation:	Permit boundary
Geochemistry:	Permit boundary
Groundwater:	Spring Creek and Clancy Creek drainages
Surface Water:	Spring Creek and Clancy Creek drainages
Wetlands:	Clancy Creek and Pen Yan Creek drainages
Wildlife:	Premine baseline wildlife study area
Fisheries and Aquatics:	Clancy Creek drainage
Social and Economic:	Lewis and Clark and Jefferson counties

The purpose of this cumulative effects analysis is to ensure that agency decisions consider the full range of consequences of their action.

Reasonably foreseeable future actions in the vicinity of the project area are described in Section 2.8. Present and past actions in the vicinity of the Montana Tunnels Mine include mining, reclamation, grazing, hunting, general recreation, weed management, fire fuel mitigation, and road maintenance. The agencies contacted the following

sources for the most up-to-date information regarding ongoing projects and activities in the Montana Tunnels area:

- Montana DEQ Environmental Management Bureau regarding small miner and exploration programs (McCullough 2007). No mineral exploration is taking place in the immediate area of Montana Tunnels. Two small miners are listed in the area, one inactive and the other a new operation. No cumulative effects would be expected.
- Montana DEQ Industrial and Energy Minerals Bureau regarding open cut mining sites (Harrington 2007). No permitted opencut mining sites nor pending opencut mine applications are within any section of T7N, R4W. No cumulative effects would be expected.
- Montana DEQ Remediation Division regarding abandoned mine reclamation efforts in the area (Sturm 2007). Cumulative effects from abandoned mine reclamation projects are discussed below.
- Jefferson County Planning Department regarding subdivision activity (Stepper 2007). Cumulative effects from subdivisions are discussed below.
- U.S. Forest Service regarding projects in the area (Fauntleroy 2007). The USFS identified two projects for possible cumulative effects analysis. First, the Clancy-Unionville Grass Burning on five units totaling approximately 406 acres west of Montana Tunnels across four sections. The acres are approximate and analyzed in the Clancy-Unionville Final Supplement EIS (February 2003). The EIS is currently in the courts and is awaiting the 9th Circuit hearing date, so the projects are on hold. And, second, the Clancy Grazing Allotment. The Clancy Allotment is directly west of Montana Tunnels and is currently running 80 to 90 pair of cattle. Cumulative effects from USFS projects are discussed below.
- The Elkhorn Goldfields Golden Dream Project application to DEQ (Elkhorn Goldfields 2007). Cumulative effects from the Elkhorn Goldfields application are discussed below.
- Montana Fish, Wildlife and Parks regarding fisheries and aquatics projects (Spoon 2007). Clancy Creek, Kady Gulch, and Quartz Creek all have limited populations of cutthroat trout, and all 3 populations are being monitored. There are no current or proposed projects involving cutthroat trout in the area. There have been successful restoration projects east of Interstate 15 from the mine in Duchman Creek, Prickly Pear Creek, South Fork of Warm Springs Creek, and Muskrat Creek. No cumulative effects would be expected.

The following projects or activities were identified as within the cumulative effects region for the Montana Tunnels Mine: (1) subdivisions in the immediate Montana Tunnels area, (2) the Elkhorn Goldfields proposed Golden Dream Project, (3) reclamation of abandoned mines in the area, and (4) possible closure of the Golden Sunlight Mine. All projects or activities would not affect all resources. Resources that

could possibly include cumulative impacts are discussed for each project or activity below.

Subdivisions in the Immediate Montana Tunnels Area

Northern Jefferson County has experienced rapid growth in the last decade. In the last 8 years, over 800 lots have been created in Jefferson County (Stepper 2007). In the immediate Montana Tunnels area, five subdivisions are planned or approved. They include: (1) the planned Trestle Minor Subdivision (5 lots on approximately 10 acres), (2) the planned Meadowlark Ridge Major Subdivision near Corbin (47 lots on approximately 107 acres), (3) the planned Lump Gulch Minor Subdivision (5 lots on approximately 20 acres), (4) the planned Sheep Mountain minor subdivisions (5 lots each on each of 4 minor subdivisions), and (5) an approved subdivision adjacent to and east of Meadowlark Ridge (3 lots). This discussion refers to these subdivisions as "planned subdivisions." Subdivisions in the immediate Montana Tunnels area would cumulatively affect the following resources: geology and soils; water, fisheries, and aquatics; socioeconomics; wildlife; and cultural resources.

Geology and Soils. Planned subdivisions in the area surrounding the mine permit boundary could create some minor changes to surficial geologic deposits and limit potential future mineral exploration and mining in those areas. Cumulative and potential loss of soils and impacts to vegetation in the area could occur from planned subdivisions. Noxious weeds are known to exist within the study area, and additional disturbances to soils and plant communities would likely increase noxious weeds. The cumulative impact of these activities on soil and vegetation would depend on the timing, duration, and degree of implementation of BMPs for these potential developments.

Water, Fisheries, and Aquatics. Planned subdivisions could impact groundwater. No municipal source of water is planned; therefore, newly installed production wells would likely provide potable water for all planned subdivisions. These new demands for groundwater would impact groundwater availability in the Spring Creek basin. Assuming each lot uses an average of 0.62 gpm (0.0014 cfs) (Montana Water Resources Board 1982), the combined total groundwater withdrawal for all new development would be about 34 gpm (0.076 cfs). The withdrawal of 34 gpm (0.076 cfs) of groundwater would be a cumulative impact. More recent estimates of domestic groundwater withdrawals are lower than these numbers (Cannon and Johnson 2004), so this discussion uses the older but more conservative numbers for the analysis.

Planned subdivisions could impact surface water. New construction activities, especially for roads in the new and planned subdivisions, would result in soil erosion leading to a temporary increase in total suspended solids (TSS) in adjacent streams during the construction period, even if BMPs to control erosion were used. The potential increase in TSS cannot be quantified and would depend on the location of the subdivisions and effectiveness of the BMPs used. Soil erosion and increased concentrations of TSS in adjacent streams would persist until revegetation of the disturbed areas was complete. The temporary increase in TSS during the construction period would be a cumulative impact.

The cumulative impact of subdivisions on fish populations and aquatic resources in the Prickly Pear Creek drainage area would depend on the effects to stream habitat, water quality, and water quantity. The potential change would be difficult to determine because the exact location and extent of future activities is unclear. Implementation of BMPs during construction, timber management activities, and during road construction and maintenance should minimize impacts to aquatic habitat.

A change to surface and groundwater flow patterns as a result of planned subdivisions or other developments could occur, but the loss cannot be quantified using existing data.

Socioeconomics. Recent and planned subdivisions would result in an increase in population in Jefferson County. The increase in population would result in greater taxes paid to the county, but also would require additional infrastructure (*e.g.*, roads) and services (*e.g.*, garbage). Increased populations would also likely result in benefits to local businesses as more goods and services are purchased in the area. Increased populations could result in potential conflict between mining and residential quality of life. Increased population would result in cumulative impacts on recreation in the area with greater numbers of people using recreation resources.

Wildlife. Recent and planned subdivisions would cumulatively impact wildlife. More subdivisions and homes near the mine would increase local recreation and hunting pressure and fragment wildlife habitat resulting in mortality or disturbance to wildlife, particularly game species. An increase in residential development would reduce habitat availability or suitability for elk and deer. An increase in human population could result in increased local recreation and hunting pressure on elk and deer, resulting in mortality or disturbance. The discernment of cumulative impacts to elk and deer from increases in human population is difficult. In addition, the effects of prolonged drought on the numbers and distribution of elk and deer have not been quantified.

Increasing human population in Jefferson County would likely result in increased human activity on public and private land that could disturb lynx. Planned

subdivisions are not within lynx habitat. Therefore, cumulative effects to lynx from habitat loss due to development would not be anticipated. Timber management on private and public land within lynx habitat could also result in loss of lynx foraging and denning habitat.

More detailed, species by species discussions of the potential cumulative effects of residential development on wildlife are presented the Biological Evaluation (in the project file) and the Biological Assessment.

BLM Sensitive Wildlife Species. Recent and planned subdivisions would likely result in more aggressive wildfire control and limit the extent and distribution of preferred black-backed woodpecker habitat. Subdivisions in sagebrush/grassland habitats could further reduce availability of habitat for Brewer's sparrow. Subdivisions could result in the clearing of potential flammulated owl habitat and contribute to cumulative impacts to flammulated owl populations.

Recent and planned subdivisions would contribute to increases in traffic on nearby public roads and recreation on public lands. Increased traffic could result in an increase in availability of carrion from wildlife-vehicle collisions. Eagles foraging on carrion along roads would be at risk of mortality from vehicle collisions. Increasing recreational activity on public lands could potentially disturb foraging or nesting golden eagles.

Recent and planned subdivisions within the wildlife baseline study area would likely result in loss of additional nesting and foraging habitat for great gray owls. This potential loss of habitat would be additive to habitat lost to mine development. Residential development would also contribute to increases in traffic on nearby public roads and recreation on public lands. Increased traffic could result in an increase in mortality risk to owls foraging along road rights-of-way. Bald eagles foraging on carrion along roads would also be at risk of mortality from vehicle collisions. Because of the lack of bald eagle habitat in the immediate vicinity of Montana Tunnels, cumulative impacts to bald eagle habitat are not expected under any alternative.

Recent and planned subdivisions within the wildlife baseline study area would likely result in the loss of additional nesting and foraging habitat for loggerhead shrike. This potential loss of habitat would be additive to habitat lost to mine development. Pets, particularly cats, from neighboring subdivisions could increase mortality of passerine birds, such as loggerhead shrike.

Recent and planned subdivisions in mature to old-growth forest habitat within the baseline wildlife study area could reduce and fragment the existing potential goshawk nesting and foraging habitat. This potential loss of habitat would be additive to habitat lost to mine development.

Residential development that involves removal of mature and old-growth trees would impact bat roosting and foraging habitat. Degradation of wetland and riparian habitats and water quality resulting from planned subdivisions, commercial development, or livestock affecting riparian and wetland habitats and water quality could result in decreased insect populations and adverse impacts to bats.

Winter recreational travel (backcountry skiing and snowmobiling) has the potential to disturb denning wolverine. The increase in human population of Jefferson County could result in increased winter recreational activity in wolverine denning habitat.

Land management practices on private and public land that affect riparian and wetland habitats and water quality could affect western toad breeding and foraging habitat. Residential development that could impact riparian and wetland habitats would likely result in the additional loss of toad breeding habitat. Increased vehicle traffic associated with residential development could increase the risk of mortality for western toads.

Cultural Resources. Development activities, including the existing Montana Tunnels Mine as well as the establishment of rural residential subdivisions and reclamation of historic mines and mine wastes in the Spring Creek, Corbin, and Wickes area have impacted the historical character of the Colorado (Wickes) Historic Mining District. Expansion of mining operations at Montana Tunnels would be relatively minor compared to the disturbance that has already occurred. Planned subdivisions could further impact the historical scene by the addition of modern structures.

USFS Burning Projects and Grazing Allotment

Prescribed burning on 406 acres west of Montana Tunnels would degrade air quality in the short term, during the actual burning. All prescribed burn treatments would incorporate appropriate pre- and post-herbicide treatment. Although mining-related activities at the Montana Tunnels Mine are a source of particulate and gaseous air pollutants, they are controlled using best available control technology consisting of good engineering practices, including minimization of drop heights during loading and dust suppression. The Montana Tunnels project would continue to comply with ambient air quality standards and have no cumulative impact with the short-term USFS burning.

Burning would also affect aesthetics in the short term. Although the Montana Tunnels expansion would increase aesthetic impacts during operations, especially from the roads accessing the nearby National Forest System lands, and for residents in Wickes, Cumulative impacts are not expected to occur on account of the very short term nature of the burning project.

The current Clancy Grazing Allotment continues ongoing range management of the area. In a decision memorandum dated January 23, 2006, the USFS determined that ongoing grazing management is meeting, or satisfactorily moving toward, USFS objectives in land and resource management (Harp 2006). Comparison of the old allotment vegetation maps and those from the late 1990s and allotment inspection reports indicate that range conditions are being maintained or are improving towards the desired condition. Adaptive management has been used to adjust management of the allotments to improve rangeland and riparian condition. The Montana Tunnels project would not be expected to change the range condition nor management of this allotment and no cumulative effects are anticipated.

The Elkhorn Goldfields Proposed Golden Dream Project

This proposed mine, located 20 miles to the south of Montana Tunnels Mine, would employ up to 70 people for up to 5 years. The project would consist of a 500- to 1,000-ton-per-day mechanized underground mining operation with the ore being trucked using over-the-road trucks to Montana Tunnels for concentration (Elkhorn Goldfields 2007). Additional extraction of minerals associated with the Elkhorn Goldfields proposed Golden Dream Project in Jefferson County could occur if this mine is permitted. Details related to resource extraction and metals production are currently unknown. If permitted, tailings from this proposed mine could report to the Montana Tunnels tailings impoundment. The proposed Elkhorn Goldfields Golden Dream Project would cumulatively affect geochemistry and socioeconomics.

Geochemistry. As discussed in Section 3.2 , Montana Tunnels has entered into a custom milling agreement with Elkhorn Goldfields, Inc., whereby ore from the Elkhorn Goldfields Golden Dream Project could be milled at Montana Tunnels' existing Diamond Hill milling circuit. The Diamond Hill mill is located within the Montana Tunnels mill complex. Ore from the Diamond Hill Mine near Townsend was shipped to the mill at Montana Tunnels for processing. It is reasonable to assume that tailings generated from Elkhorn Goldfields ore would be placed into the tailings storage facility at Montana Tunnels, but only if geochemical characterization of the Elkhorn Goldfields materials is determined to have no negative effects on the nonreactive nature of the Montana Tunnels tailings materials. Montana Tunnels would make the final decision on whether to allow Elkhorn Goldfields material to be processed through the Diamond Hill circuit when full material characterization has been received.

Data are being gathered to assess the behavior of tailings that would be generated from Elkhorn Goldfields ore. Elkhorn Goldfields tailings may behave differently than the Montana Tunnels tailings in the tailings storage facility. In this event, the potential exists for acid-generating or near-neutral metal producing material to be placed on the top of existing Montana Tunnels tailings. Acid generated by new material from Elkhorn Goldfields could trigger faster and more widespread oxidation of the coarse-

grained sulfide minerals at Montana Tunnels that currently do not generate acid. The potential for this cumulative impact to occur is currently unknown, because the necessary geochemical data from the Elkhorn Goldfields project are not yet available.

Socioeconomics. The Elkhorn Goldfields project if permitted would produce cumulative socioeconomic effects. It would employ up to 70 people for up to 5 years. Jefferson County would receive tax revenues both from the mine and from the workers at the mine.

Reclamation of Abandoned Mines

Dozens of abandoned mine workings, including shafts, adits, pits, mine tailings, and waste rock piles, are located within the Colorado Historic Mining District. While there are no other large scale active mines within this district at this time, there is limestone mining (Ash Grove Cement Company) occurring within the Prickly Pear Creek drainage area about 20 miles northeast of the Montana Tunnels site. A heap leach gold mine (Basin Creek Mining, Inc.) ceased operations about 12 miles northwest of the Montana Tunnels site in the early 1990s; the Luttrell Pit at the site is still being used as a repository for abandoned mine wastes from the surrounding area. While these past or present actions are located in the vicinity of the Montana Tunnels Mine, no cumulative impacts would be anticipated.

The DEQ Remediation Division has completed many abandoned mine reclamation projects in the area surrounding Montana Tunnels including (1) the Washington Mine, (2) Belle Lode Mine, (3) Wickes Smelter, (4) Alta Mine, (5) Bertha Mine, (6) Gregory Mine, (7) Blue Bird Mine and (8) Argentine Mine, all in the Spring Creek drainage area. The reclamation at these sites has included recontouring and revegetating the surface, removing mine wastes from surface waters, eliminating physical hazards, and improving visual impacts from the unreclaimed mine sites. The reclamation of abandoned mines would cumulatively affect geology and soils, water resources, and wildlife.

Geology and Soils. Reclamation of abandoned mines in the area may limit the potential redevelopment of any mineral resources in those areas in the future. The reclamation of abandoned mined lands in the Prickly Pear Creek drainage has improved the potential for soil and vegetation development on the reclaimed lands. Noxious weed spread should also be limited by the reclamation activities. Montana Tunnels has an approved mine reclamation plan and has successfully reclaimed approximately 200 acres. The M-Pit Mine expansion under Alternatives 2 and 3 would impact undisturbed soils and vegetation and require additional areas to be reclaimed. In addition to the impacts of the proposed mine expansion, other activities within the study area would be expected to continue to disturb soils and vegetation within the foreseeable future.

Water Resources. The cleanup of the Washington Mine, immediately adjacent to Montana Tunnels in the Pen Yan Creek drainage, in 2007 should result in an improvement in the surface water and groundwater quality in the Pen Yan Creek drainage. The mine cleanup should also result in geochemical changes that would improve the water quality in the Pen Yan Creek drainage. Reclamation of the Washington Mine area in 2007 has changed the historical look of the Pen Yan Creek drainage area.

Wildlife. Cumulative impacts to BLM sensitive bats could result from reclamation of mine sites, closure of underground mine openings, and removal of old buildings. Such activities would reduce available roosting habitat.

More detailed, species by species discussions of the potential cumulative effects of reclamation projects on wildlife are presented the Biological Evaluation (in the project file) and the Biological Assessment.

Possible Closure of the Golden Sunlight Mine

Golden Sunlight Mine in Jefferson County, Montana, is scheduled to close in 2009. Closure of the Golden Sunlight Mine would cumulatively affect socioeconomic resources.

With the possible closure of the Golden Sunlight Mine, the high paying jobs and other economic benefits from Montana Tunnels could increase in importance for Jefferson County. Golden Sunlight has also been an important taxpayer in Jefferson County. According to the Final Supplemental EIS for the Golden Sunlight Pit Reclamation (DEQ 2007), Golden Sunlight paid $309,232 in property taxes to Jefferson County in 2002.

If the Golden Sunlight Mine shuts down in the next few years, the historical contribution of Montana Tunnels to the local economy would become even more important due to a temporary increase in unemployment and a permanent loss of high paying jobs and tax revenue from that closure. Five years of additional operations at Montana Tunnels would help to alleviate some of the economic difficulties caused by a Golden Sunlight Mine closure. If Montana Tunnels were to shut down at the same time as Golden Sunlight, the adverse effects would be exacerbated by two mines shutting down at once.

GSM submitted an application for a revision to Operating Permit 00150 (Pit 5B Optimization revision) on December 12, 2007. The proposed revision would increase the depth of the pit by 125 feet, and extract about 53 million tons of waste rock. The waste rock would be placed on existing waste rock dumps. Approximately ten acres of the West Waste Rock Dump Complex would be converted to mine pit disturbance due

to pit layback. Approximately eight million tons of tailings would be placed in Tailings Impoundment No. 2. This would increase the height of the impoundment by up to 20 feet and expand the area by about 5 acres. All proposed disturbances with the mine pit expansion, waste rock dumps, and tailing impoundment would be located within the existing permit and disturbance boundaries. It is estimated that the Pit 5B Optimization revision would extend the life of the mine by five years.

4.2 Unavoidable Adverse Effects

4.2.1 Geology and Minerals

The M-Pit Mine Expansion would result in the mining of an additional 24 to 28 million tons of ore, disposal of 46.2 million cubic yards of waste rock in waste rock storage areas, and disposal of 28 million tons of tailings in the tailings storage facility. For both action alternatives, there would be a larger M-Pit mine (+16 percent), larger waste rock storage area (+36 percent), and larger tailings storage facility (+5 percent). If the Agency Mitigated Alternative 3 is selected, another 4.9 million cubic yards of waste rock would be produced to layback the hill slope above the relocated Clancy Creek channel.

4.2.2 Geotechnical Engineering

Under both action alternatives, the M-Pit excavation would be extended an additional 200 feet in depth. The mine expansion would result in a larger pit area. The M-Pit Mine Expansion would expose weaker rock within some of the highwalls resulting in more potential small highwall instability problems. Under Alternative 2, at closure, before filling the pit lake, the factor of safety (FOS) for various pit highwall sectors would range from a low of 1.11 (southwest highwall) to a high of 1.33 (east and southeast highwalls). After filling of pit lake, the FOS would increase to a low of 1.34 (southwest highwall) to a high of 1.94 (southeast highwall). A FOS of 1.3 is widely accepted for long-term stability of open pit mine slopes. See the discussion in Section 3.3, Geotechnical.

4.2.3 Soil, Vegetation, Reclamation

Soil impacts result from the removal, storage, and replacement of soils during mining include loss of soil development and horizonation, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of impacts determines, in part, the potential success of reclaiming the areas to forested areas, grasslands, and wildlife habitat. The disturbance area and impact for Alternatives 2 and 3 would be greater than for Alternative 1.

4.2.4 Geochemistry

Waste rock and ore mined under the Alternative 1 (L-Pit) and Alternative 2 (M-Pit) plans would behave similarly from a geochemical perspective. Static acid-base accounting (ABA) testing appears to suggest the potential for acid generation from ore and waste rock exists, especially for materials excavated from depths below 5,100 feet. These data are conservative as shown by kinetic tests that consistently fail to produce acid from samples classified as acidic based on ABA data. Therefore, acid generation is not predicted. As the pit deepens the potential for acid generation could increase. Alternative 3 ore and waste rock encountered at depth would be further evaluated through an operational geochemical verification program that includes a more detailed sampling plan and kinetic testing.

4.2.5 Groundwater

Under both Alternatives 2 and 3, 1,800 feet of the Clancy Creek alluvial aquifer would be excavated and removed during mine operations. The loss of that portion of the alluvial aquifer would be an unavoidable impact.

The M-Pit lake elevation, area, and volume would increase through time and would reach equilibrium at elevation 5,625 about two centuries after mining ceases. At that time, at least 360 gpm (0.08 cfs) of pit lake water would begin to seep to groundwater in the Spring Creek drainage through relatively permeable zones located along the southeast side of the mine pit (Montana Tunnels 2007). The diversion of surface water from Clancy Creek into the M-Pit for Alternative 2 and resulting seepage from the pit lake to groundwater in the Spring Creek drainage would be an unavoidable adverse impact to the existing surface water flow system in Clancy Creek.

4.2.6 Surface Water

Under Alternatives 2 and 3, 1,800 feet of Clancy Creek channel would be excavated and removed during mine operations. The loss of 1,800 feet of Clancy Creek channel would be an unavoidable impact. Approximately 3,800 feet of the existing Pen Yan Creek channel would be covered with waste rock under Alternative 2.

The expansion of the mine pit would reduce the surface water catchment area for the Clancy Creek drainage by about 28 acres in the immediate area of the M-Pit. The average annualized loss of flow in Clancy Creek associated with the 28 acre reduction in catchment would be about 5.2 gallons per minute (0.011 cfs) (Montana Tunnels 2007).

4.2.7 Wetlands

For both action alternatives, mining would impact 2.63 acres of wetlands. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation. The total wetland disturbance would be 4.77 acres.

4.2.8 Wildlife

Loss of wildlife habitat and ungulate winter range due to the unvegetated pit would constitute a permanent loss of those resources. The L-Pit under Alternative 1 represents 248 acres of lost habitat, while under Alternative 2 the pit represents 288 acres of lost habitat. As noted by DSL (1986), wildlife habitat types disturbed by mine development are abundant in the vicinity of the mine. WESTECH also noted that ungulate winter range was abundant in the vicinity of Montana Tunnels (Montana Tunnels 2007). As reported by WESTECH, FWP recorded that residential development in northern Jefferson County is diminishing the effectiveness of ungulate winter range in that area due to direct loss of habitat and increased human activity and motorized use (Montana Tunnels 2007).

In addition to the direct loss of ungulate winter range, wintering animals could be displaced as a result of human activity associated with the mine. Displacement and added physiological stress would reduce effectiveness of winter range habitat adjacent to the mine. These effects would persist through the life of the mine, until successful reclamation could be achieved and human activity at the mine site is diminished. Ungulates would be expected to resume use of the area to some extent after reclamation.

For both action alternatives Montana Tunnels would donate the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation, and there would continue to be human activity at the site that could disturb and displace wildlife. This would constitute a perpetual impact to wildlife and wildlife habitat. The impact to wildlife for Alternative 3 would be less as a result of limiting motorized travel in important winter and summer ranges and mine site reclamation objectives that restrict some potential uses.

While a goal of reclamation would be to restore the land for livestock grazing and wildlife grazing and habitat, restoration of some habitat types could take a long time. Reestablishment of mature forest conditions could take more than 100 years. The wildlife values associated with such habitats would not be realized for a long time.

4.2.9 Fisheries and Aquatics

Under Alternative 2, diversion of Clancy Creek into a 2,000-foot-long pipe would result in a permanent barrier to upstream fish migration and reduction in the available habitat for the cutthroat trout population present in Clancy Creek within the vicinity of the mine. The loss of habitat connectivity could threaten the persistence of the cutthroat trout population over time. If habitat or number of individuals in the cutthroat trout population upstream of the mine is insufficient to maintain the population, this loss of habitat could lead to a loss of the cutthroat trout population. However, due to the low numbers of fish sampled, lack of information on life history parameters, and uncertainty about genetic purity due to the time that has passed since genetic sampling was done, the potential for this population loss to occur would be difficult to quantify.

4.2.10 Socioeconomics

The social changes to Jefferson County would include the long-term adverse impact of the loss of approximately 80 full time jobs within Jefferson County (out of 180 total full time jobs lost within all of Montana) in 2009 as opposed to the loss of those jobs in 2013 for Alternative 2. For Alternative 1, Jefferson County residents would be adversely impacted in the long term at a personal level by loss of wages, and county government would be impacted by the loss of royalty and tax income. Alternative 1 would adversely impact local tax revenue for Jefferson County in the long term, in particular the revenues earmarked for the Clancy Elementary School District and the Boulder High School District. Both action alternatives would incur higher road maintenance costs for Montana Tunnels.

4.2.11 Cultural Resources

Consultation with the State Historic Preservation Office was completed in August of 2007. Three of the newly recorded sites have been determined "not eligible" and will not be affected by mine operations. One site was determined to have lost too many characteristics to be considered a site and will not be adversely affected by mine operations. One last site, the Old Mine site, was determined "eligible" for listing on the National Register of Historic Places. Disturbance of this site would require further consultation with the State Historic Preservation Office to determine the type of data recovery needed to mitigate the impacts of mine operations.

4.3 Irreversible and Irretrievable Commitment of Resources

Irreversible resource commitments are generally related to the use of nonrenewable resources, such as minerals or cultural resources, and the effects this use could have on future use options. Irreversible commitments are usually permanent, or at least persist for a very long time. Irretrievable resource commitments involve a temporary loss of the resource or loss in its value.

Irreversible or irretrievable commitments of resources are described below for those disciplines where they were identified. Irreversible or irretrievable commitments of resources were not identified for several disciplines, including geotechnical engineering, geochemistry, and socioeconomics.

4.3.1 Geology and Minerals

An additional 24 to 28 million tons of ore would be removed from the mineral resource at the Montana Tunnels Mine, and mine waste rock and tailings would be placed on the surface during mining. Mining results in an irreversible commitment of these mineral resources.

4.3.2 Soil, Vegetation, Reclamation

The impacts to soil would be considered irreversible because natural soil development and mine soil redevelopment are continual processes, but would take a long time. The redeveloped mine soils would ultimately achieve a similar level of soil quality as the pre-mine existing soils.

Irretrievable impacts to vegetation resources would occur under either action alternative. Soil would be salvaged and redistributed over the reclaimed areas, and all disturbed areas would be reseeded with the approved reclamation seed mixture. As a result, the loss of soil and vegetation habitat would not likely be permanent. Noxious weeds and weed control would increase and displace and eliminate native species as a result. This loss of native species would be irretrievable.

4.3.3 Groundwater

No irreversible commitments of groundwater have been identified. Groundwater would continue to discharge into the pit for almost two centuries in all alternatives and eventually return to the groundwater system when the pit lake level reaches equilibrium. The loss of 1,800 feet of alluvial aquifer in the Clancy Creek channel as a result of pit excavation during the M-Pit Mine expansion would be an irretrievable commitment of a resource.

4.3.4 Surface Water

Under Alternative 2, a portion of Clancy Creek would be diverted into the M-Pit to help form a pit lake. The actual amount of Clancy Creek surface water to be used for this purpose was not explicitly stated by Montana Tunnels. The diversion of surface water flows from Clancy Creek into the mine pit would be an irreversible commitment of a resource.

The excavation and removal of 1,800 feet of the natural Clancy Creek channel would be considered an irreversible resource commitment under Alternative 2, and an irretrievable resource commitment under Alternative 3.

The expansion of the M-Pit Mine would reduce the surface water catchment area for the Clancy Creek drainage by about 28 acres. The average annualized loss of flow in Clancy Creek associated with the 28-acre reduction in catchment would be about 5.2 gallons per minute (0.011 cfs). The loss of 5.2 gallons per minute (0.011 cfs) of flow to Clancy Creek would be an irreversible commitment of a resource.

4.3.5 Wetlands

For both action alternatives, the impact to wetlands in the M-Pit Mine Expansion area would be an irretrievable commitment of resources. However, new wetlands would be created in the existing drainage with generally the same vegetation types (emergent, scrub-shrub, and forested wetlands). The conceptual wetlands mitigation plan includes a monitoring plan with specific performance standards to help ensure that the mitigated wetlands provide comparable functions and values to the wetlands lost to mining.

4.3.6 Wildlife

The M-Pit Mine would increase by 39.3 acres over the L Pit, resulting in loss of habitat for some species, such as deer, elk, and moose. Portions of the remaining highwall might be used by bats and birds for nesting or resting. This loss of wildlife habitat would be considered irreversible.

4.3.7 Fisheries and Aquatics

Irreversible impacts to aquatic resources would occur under Alternative 2, because 1,800 feet of habitat would be lost with diversion of Clancy Creek into a pipe. This loss of habitat would result in a permanent barrier to upstream fish migration and permanent isolation of westslope cutthroat trout from downstream populations in the Prickly Pear Creek drainage. If habitat or numbers of individuals in the cutthroat trout population upstream of the mine are insufficient to maintain the population, this could

lead to an irreversible loss of this population. Due to the low numbers of fish sampled in 2004, lack of information on life history parameters of the population, and uncertainty about genetic purity due to the time that has passed since the last sampling in Clancy Creek upstream of the proposed diversion, the potential for this irreversible resource commitment would be difficult to quantify.

Under Alternative 3, the habitat commitment would be irretrievable. The Clancy Creek channel would be reconstructed, and habitat would develop along the new channel. Potential isolation of westslope cutthroat trout would be temporary.

4.3.8 Cultural Resources

Four of the five sites within the mine permit boundary have been determined "not eligible" for listing on the National Register of Historic Places. Mine operations will have "no adverse effect" on those properties.

In addition to the above referenced four cultural resources, the setting of the old mine has the potential to be impacted by the proposed contingency waste rock storage area. Impact to the property's setting (one of the seven aspects of historical integrity) would represent an irretrievable impact.

4.4 Secondary Impacts

Secondary impacts are those impacts that would occur at a different location and/or time than the action that triggers the effect. Secondary impacts associated with the proposed project have been identified for socioeconomics and wildlife. Secondary impacts for each of these disciplines are summarized below.

4.4.1 Socioeconomics

Once the mine closes, there would be two effects that would occur outside Jefferson County. The first is that the beneficial metals extracted from the mine would no longer be produced for national and world use. The second is that all businesses that supply the mine with equipment or other goods would lose those sales. Some of these businesses are located in other parts of Montana and some out of state.

4.4.2 Wildlife

Because many wildlife species are wide-ranging or migratory, impacts to wildlife from mining activity can result in secondary off-site impacts. Displacement of wildlife can cause animals to move into potential habitat elsewhere, some of which could be suboptimal. This can lead to increased population density and increased intraspecific

and interspecific competition away from the mine. Displacement of wildlife into suboptimal habitat or increased competition can reduce nutritional status of wildlife and adversely affect reproduction or survival. Displaced ungulates (elk, deer, and moose) could spend more time on adjacent private land, leading to increased utilization of forage that would otherwise be available for livestock or result in other wildlife and human conflicts.

The 1986 final EIS noted the potential for small increases in poaching, wildlife harassment, and road kills related to mine development (DSL 1986). Most of these impacts would likely occur away from the Montana Tunnels Mine. These potential impacts could occur under all three alternatives.

4.5 Regulatory Restrictions

Alternatives and mitigation measures are designed to further protect environmental, cultural, visual, and social resources, but they also add to the cost of the Project. In 1995 the State legislature amended MEPA to require State agencies to evaluate the regulatory restrictions proposed to be imposed on the proponent's use of private property (Section 75-1-201(1)(b)(iv)(D), MCA). Alternatives and mitigation measures that are required by federal or state laws and regulations to meet minimum environmental standards do not need to be evaluated for extra costs to the proponent. This section addresses only those alternative components or mitigation measures that are regulatory restrictions. For a complete description of Alternative 3 and the mitigation measures the agencies may adopt, please see Section 2.4.

Integral components of Alternative 3 and mitigation measures that might be imposed by the agencies under Alternatives 2 or 3 would add up to an estimated $12.7 million to the cost of the proposed project. Integral components of Alternative 3 are (1) the hillside layback and associated constructed open-flow channel for Clancy Creek, (2) fencing of the restored Clancy Creek channel area, and (3) diversion structures on Clancy Creek for a fish barrier.

Mitigation measures that could be applied to Alternatives 2 or 3 include: (1) measures to improve waste rock storage area construction, (2) measures that affect reclamation of waste rock storage area surfaces, (3) development of verification program for water quality, (4) development of an operational geochemical verification program, (5) measures to address geotechnical issues related to pit highwall stability, (6) measures to facilitate reclamation of the tailings storage facility surface, (7) measures related to site management, and (8) documentation of sites eligible for National Register of Historic Places. The additional costs of Alternative 3 and the mitigation measures that could be applied to either Alternative 2 or 3 and considered for the regulatory restrictions analysis are discussed below.

4.5.1 Integral Components of Alternative 3 Resulting in Regulatory Restrictions

A 36.9-acre layback of the hillside northwest of the mine pit adjacent to Clancy Creek would be required to route the creek into a constructed open-flow channel soon after commencing the M-Pit Mine expansion in Alternative 3. The constructed channel would be designed to mimic the existing Clancy Creek channel, lined to limit seepage, and convey the 1 in 20 year return period 24 hour storm event. About 4.9 million cubic yards of excavated layback rock would be hauled to existing waste rock storage areas or a contingency waste rock storage area. The cost of this component is estimated to be $5.1 million.

The open-flow channel is needed to minimize the potential for Clancy Creek to report to the M-Pit, maintain aquatic habitat, and minimize impacts to wetlands. It also complies with the Corps of Engineers requirement to examine alternatives during Section 404 permitting.

In Alternative 3, the restored Clancy Creek channel area would be fenced, and the fence would have to be maintained to discourage livestock grazing and other channel disturbances from humans in order to preserve habitat in the long term. The cost of this mitigation measure is estimated to be $57,000. This measure is needed to prevent impacts to water quality and wetlands.

The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future in Alternative 3. The cost of this mitigation measure is estimated to be $10,000.

4.5.2 Mitigation Measures Applicable to Alternatives 2 or 3 Resulting in Regulatory Restrictions

Mitigation 1

Montana Tunnels would continue to construct the waste rock storage areas using lift heights of 50 feet for Alternatives 2 and 3. The cost of this component is estimated to be $4.6 million.

The measure is needed to limit impacts to groundwater and surface water by improving the reclamation potential of the waste rock storage area slopes and limiting the slope lengths that have to be graded and reclaimed. This measure limits the potential failure of reclaimed waste rock dump slope engineered benches and minimizes long-term maintenance of surface water drainage channels.

Mitigation 2

The sides of the waste rock storage areas would be regraded with concave slopes and a dendritic drainage pattern. The cost of this component is estimated to be $459,000. This could also be applied to Alternative 2 as a mitigation measure.

This measure is needed to limit impacts to groundwater and surface water by minimizing the potential for failure of reclaimed waste rock dump slope engineered benches and minimize long term maintenance of surface water drainage channels.

Mitigation 3

An operational verification program would be implemented to confirm estimates made in this EIS of M-Pit lake water quality and seepage from the tailings storage facility for all alternatives. The operational verification program would include quarterly measurement of flow and water quality from the tailings storage facility combined drains and flow into the mine pit. Flow and water quality data would be compared to model predictions and calibrated using operational data. The calibrated models would be rerun, and, if necessary, pit water or tailings storage facility seepage would be managed or treated, as appropriate. The cost of this component is estimated to be $65,000.

This measure is needed to limit impacts to groundwater and surface water by identifying trends in flow and quality in case other mitigations are needed.

Mitigation 4

Montana Tunnels would develop a contingency plan and operational geochemical verification program to handle potentially acid-generating waste rock based on static and kinetic test results, and on-going monitoring for all alternatives. The cost of this component is estimated to be $18,000.

This measure is needed to limit impacts to groundwater and surface water by identifying potential problematic waste rock and ore. This measure is needed to prevent impacts to water quality and wetlands.

Mitigation Measure 5

Montana Tunnels would implement operational and geotechnical measures (low-damage blasting practices for Alternatives 2 and 3, aggressive groundwater depressurization for all alternatives, and implementation of a proactive geotechnical

monitoring program for all alternatives) to ensure Clancy Creek flows do not enter the mine pit in the future. The cost of this mitigation measure is estimated to be $420,000.

The mitigation is needed to limit impacts to groundwater and surface water flows. It is not a regulatory restriction that needs to be evaluated for adding extra cost to the Project.

Mitigation Measure 6

During reclamation, if needed, Montana Tunnels would implement a site specific dewatering plan to reduce tailings slimes fluidity so capping material can be placed without slimes displacement for all alternatives. Montana Tunnels would add additional capping material on low areas of the reclaimed tailings storage facility surface to compensate for settlement. Montana Tunnels would establish a 100-foot by 100-foot survey grid on the surface after operations cease, before cap rock is placed. As cap is placed, the grid would be checked to ensure the required amount of cap and the desired grade are achieved. Montana Tunnels would wait until most settlement occurs before placing 24 inches of soil. Long-term continued settlement would require additional soil to be placed to reestablish grade. Montana Tunnels would report survey results annually to the agencies and document that the reclamation gradient has been reestablished. The cost of this mitigation measure is estimated to be $1.3 million.

The mitigation is needed to limit seepage from the tailings by ensuring surface water runoff is maximized.

Mitigation Measure 7

Montana Tunnels would limit or restrict motorized travel in important winter and summer range; close roads on mine property to public access; close winter range areas to snowmobile use; and donate the mill structure, warehouse, administration buildings and associated land to the Jefferson Local Development Corporation, but with the requirements of using only existing building sites, reclaiming other areas to native habitat, and placing land in a protective conservation easement. This mitigation would apply to all alternatives. The cost of this mitigation measure is estimated to be $0.6 million.

This measure is needed to limit impacts to wildlife.

Mitigation Measure 8

Montana Tunnels would document sites that are determined eligible for listing on the National Register of Historic Places with photographs for Alternatives 2 and 3. The cost of this mitigation measure is estimated to be $5,000.

This measure is needed to limit impacts to cultural resources for Alternatives 2 and 3.

4.6 Short-Term Use Versus Long-Term Productivity

Short-term uses of the study area are defined as those occurring during the life of the mine and the 5-year closure period. Short-term uses are characterized by existing land use of the area as affected by the Proposed Action and alternatives. Long-term productivity of the study area addresses the time period after the 5-year closure period. Long-term productivity involves sustaining the resources in a condition sufficient to support long-term ecological, social, and economic health.

All action alternatives would manage resources within requisite regulatory standards for air quality, water quality, cultural resource preservation, and wildlife management, and thus would maintain long-term productivity as much as possible. Many of the short-term impacts of all alternatives would cease after successful reclamation of the mine.

Short-term removal and use of the ore from the pit for all alternatives would eliminate its use for long-term productivity.

Surface disturbances affecting soils, vegetation, and wildlife from all action alternatives would be short term, except in the pit area which would not be revegetated. It would take over a century for a pit lake to form for all alternatives. Long-term productivity of soil and vegetation would be restored after reclamation, even though it would take many years to redevelop soil properties and forested vegetation communities. Impacts to wildlife populations, especially elk, may never return to pre-mine levels because of mine disturbances and the cumulative impacts of subdivisions and vehicle use in the surrounding area.

Short-term impacts to water resources would not affect long-term productivity of water resources after reclamation.

Short-term impacts to aquatic habitat associated with the appropriation of 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow in Clancy Creek at a point of diversion downstream of Kady Gulch would not result in long-term impacts to fisheries and aquatic resource productivity in all alternatives.

Under Alternative 2, placing 1,800 feet of Clancy Creek in a pipe northwest of the M-Pit would reduce the long-term productivity of the creek. In addition, after mining ceases, flows from Clancy Creek would be used to fill the M-Pit to accelerate formation of a pit lake, affecting long-term productivity of the creek. Under Alternative 1, Clancy Creek would remain in its channel, preserving long-term productivity of the creek. Under Alternative 3, Clancy Creek would be placed in a constructed open-flow channel that mimics the existing creek channel, retaining the creek's long-term productivity.

Under Alternative 2, approximately 3,800 feet of the existing Pen Yan Creek channel would be covered with waste rock, and the channel would be realigned, potentially adversely affecting the long-term productivity of the creek. The new channel would be reclaimed, and eventually the long-term productivity of the creek would be restored in a different location.

Mining would adversely impact 2.63 acres of wetlands in the short term in Alternatives 2 and 3. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation for Alternative 3. The total wetland disturbance would be 4.77 acres. The total proposed mitigation is 5.13 acres. The proposed wetlands mitigation plan would create 3.0 acres of new wetlands to replace the 2.63 acres of wetlands impacted by the M-Pit Mine Expansion for an average replacement ratio of 1.14 to 1. The wetlands mitigation would restore the long-term productivity of the wetlands. Alternative 3 would provide potential for some additional wetlands to reestablish along the constructed open-flow channel for Clancy Creek, increasing long-term productivity of wetlands.

Comparison of Alternatives and Preferred Alternative

5.1 Comparison of Alternatives

Table 5.1-1 summarizes important components of the alternatives and the effects of implementing each alternative. Information presented in **Table 5.1-1** is focused on activities and effects where different levels of effects can be distinguished quantitatively or qualitatively among Alternative 1 - No Action Alternative (L-Pit), Alternative 2 - Proposed Action Alternative (M-Pit), and Alternative 3 - Agency Modified Alternative.

Modifications to Alternative 2 listed in Section 2.4 were incorporated in the development of Alternative 3 - Agency Modified Alternative. Important project components addressed in Alternative 3 (see Section 2.4) include:

- Permit Boundary
- Tailings Storage Facility
- Waste Rock Storage Areas
- Reclamation
- Clancy Creek Relocation
- Topography After Mining and Reclamation
- Geochemical Verification and Water Monitoring Programs
- Stability Requirements for Clancy Creek Channel

5.2 Preferred Alternative

The rules and regulations implementing MEPA and NEPA (ARM 17.4.617 and 40 CFR 1502.14, respectively) require that the agencies indicate a preferred alternative in the Draft EIS, if one has been identified. Stating a preference at this time is not a final decision. The preferred alternative could change in response to public comment on the draft EIS, new information that becomes available, or new analysis that might be needed in preparing the final EIS. The preferred alternative at this time is Alternative 3 - Agency Modified Alternative.

5.2.1 Rationale for the Preferred Alternative

Alternative 3 was developed by the agencies to address all issues raised during the public scoping process and to mitigate to the extent possible, those environmental impacts identified in Chapter 3 of this EIS. Alternative 3 is the preferred alternative because it results in less environmental impact than Alternative 2. Alternative 3 also results in greater economic benefits than Alternative 1 because it allows Montana Tunnels to expand the existing mine pit to access and mine additional ore resources.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Disturbed Acreage Waste Rock Storage Areas	425.9 acres	579.1 acres	579.1 acres
Cap Rock and Low Grade Stockpiles	66 acres	68.3 acres	68.3 acres
South Pond and Tailings Storage Facility Embankment Top	22.7 acres	24.7 acres	24.7 acres
Tailings Storage Facility	259.3 acres	272.6 acres	272.6 acres
Open Pit	248.4 acres	287.7 acres	287.7 acres
Pit Perimeter	16 acres	11.1 acres	54.2 acres
Facilities	37.6 acres	37.6 acres	37.6 acres
Gravel Pit Area	33.1 acres	0.0 acres	0.0 acres
Soil and Gravel Stockpiles	59.6 acres	115.3 acres	115.3 acres
Roads and Miscellaneous	30.9 acres	55.8 acres	55.8 acres
Total Acres	**1,199.5** acres	**1,452.2** acres	**1,489.1** acres
Geology and Minerals	Mining continues through 2009. L-Pit mine (248.4 acres); waste rock stored in a 425.9 acre waste rock storage area; milled ore wastes deposited in a 259.3 acre tailings storage facility.	Mining continues through 2013. Larger (+16%) M-Pit mine, larger waste rock storage area (+36%) and larger (+5%) tailings storage facility.	Same as Alternative 2 except waste rock volume would increase from the hillside layback.
	No hillside layback required to reroute Clancy Creek.	Same as Alternative 1.	A 36.9-acre layback of the hillside northwest of the mine pit adjacent to Clancy Creek would be required to route the creek into a constructed open-flow channel.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geotechnical Engineering	Erosion of the L-Pit highwalls and raveling of material onto benches would occur. Potential for smaller scale slope failures on pit highwalls and release of rock into the L-Pit similar to the failures that have previously occurred during operations.	Similar to Alternative 1, except that M-Pit Mine Expansion would expose weaker rock within some of the highwall resulting in more potential minor highwall instability problems.	Similar to Alternative 2, except that a higher level of blasting control would be used to minimize potential stability problems with the M-Pit highwall.
	The Clancy Creek channel would not be disturbed.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a 2,000-foot pipe around the M-Pit.	For increased stability, Clancy Creek would be routed to a constructed open-flow channel which would require a 36.9-acre layback of the hillside near the M-Pit. Appropriate operational and geotechnical measures would be implemented to achieve and maintain stability of the relocated Clancy Creek channel.
	A maximum waste rock storage area lift height of 50 feet would be used during construction to improve compaction.	A maximum waste rock storage area lift height of 150 feet would be used during construction.	Same as Alternative 1.

TABLE 5.1-1
Summary of Impacts from All Alternatives

Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Soil, Vegetation, and Reclamation	Soil impacts result from the removal, storage, and replacement of soil during mining and include loss of soil development and horizonation, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of impacts determines, in part, the potential success of reclaiming the areas to forested areas, grasslands, and wildlife habitat. Ongoing reclamation has successfully reestablished a grassland vegetation cover.	Soil and vegetation impacts would be similar to those described under Alternative 1 but would apply to a larger area of disturbance. Soil would be salvaged from an additional 540 acres for a total disturbance of 1,452.2 acres. Soil would be redistributed on an additional 191 acres for a total of approximately 941 acres. The revegetation plan for Alternative 2 contains the same seed mixtures and plant communities as Alternative 1.	Similar to Alternative 2, except the sides of the waste rock storage areas would be regraded with concave slopes and a dendritic drainage pattern.
	The Clancy Creek channel would not be disturbed.	Clancy Creek in the vicinity of the M-Pit would be routed in a combination 2,000-foot-long pipe and 600-foot lined channel, and a wetlands mitigation plan would be implemented along Clancy Creek downstream of the M-Pit.	Similar to Alternative 2, except Clancy Creek would be routed in a constructed open-flow channel that would be designed to mimic the existing stream channel.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geochemistry	Waste rock and ore mined under the Alternative 1 (L-Pit) and Alternative 2 (M-Pit) plans would behave similarly from a geochemical perspective. Static acid-base accounting (ABA) testing suggests the potential for acid generation from ore and waste rock exists, especially for materials excavated from depths below 5,100 feet. These data are conservative as shown by kinetic tests that consistently fail to produce acid from samples classified as acidic based on ABA data and a history of 20 years of mining which has not produced acid. Acid generation is not predicted.	Similar to Alternative 1 except that as the M-Pit deepens the potential for acid generation may increase.	Similar to Alternative 2 except that ore and waste rock encountered at depth would be further evaluated through an operational geochemical verification program that includes a more detailed sampling plan and kinetic testing.
	The L-Pit lake is predicted to have elevated concentrations of iron, sulfate and cyanide for about a decade after pit filling begins, and manganese is predicted to exceed the SMCL for almost two centuries.	The M-Pit lake is predicted to have elevated concentrations of cadmium, sulfate, and cyanide for about a decade, and manganese is predicted to exceed the SMCL for about two centuries.	Same as Alternative 2.
	Waste rock has the potential to release manganese.	Same as Alternative 1.	Same as Alternative 1 except that an alternative waste rock handling program would be implemented, if necessary.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geochemistry (Cont.)	Tailings have the potential to release iron, manganese, sulfate and cyanide.	Same As Alternative 1.	Same as Alternative 1, except that an alternative tailings facility closure plan would be implemented as follows:
			(1) Montana Tunnels would conduct kinetic oxidation tests to evaluate these possible changes for the existing tailings, for the tailings with M-Pit Mine Expansion material included, and for the tailings with M-Pit combined with Elkhorn Goldfields material. If these tests indicate differences from water chemistry predicted in this EIS, alternative capping strategies for tailings would be considered to limit oxygen flux and neutralize any acidity resulting from oxidation.
			(2) If Elkhorn Goldfields tailings are found to generate acid or produce elevated metals concentrations, Montana Tunnels would either refuse to mill Elkhorn Goldfields ore or would construct a separate tailings storage facility to segregate the tailings from material in the existing tailings storage facility. This new facility would have to be analyzed and approved in another environmental analysis.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Groundwater	Groundwater would flow into the L-Pit for almost two centuries, and would create a post-mining pit lake about 1,360 feet deep (L-Pit lake equilibrium surface at 5,610 feet minus the pit bottom at 4,250 feet). The L-Pit would not completely fill. Seepage from the L-Pit (7 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Groundwater would flow into the M-Pit for about two centuries, and would create a post-mining pit lake about 1,575 feet deep (M-Pit lake equilibrium surface at 5,625 feet minus the pit bottom at 4,050 feet). The M-Pit would not completely fill. Seepage from the M-Pit (at least 360 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Similar to Alternative 2, except that seepage from the M-Pit to groundwater in the Spring Creek drainage would be less because there would be no surface water inflow to the mine pit from Clancy Creek.
	After mining ceases, runoff from the reclaimed tailings surface and tailings storage facility seepage would be routed to the percolation pond created in the reclaimed south pond, and then infiltrated to groundwater in the Spring Creek drainage.	After mining ceases, runoff from the reclaimed tailings surface would be routed to the M-Pit. Tailings storage facility seepage would be routed the same as in Alternative 1.	Same as Alternative 2, except if there are elevated concentrations of metals or cyanide in the tailings storage facility seepage, seepage would be managed or treated until it can be discharged to the percolation pond as in Alternatives 1 and 2.
	Seepage from the waste rock storage area would infiltrate to the Spring Creek drainage.	Same as Alternative 1.	Same as Alternative 1.
	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase.	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Groundwater (Cont.)	The Clancy Creek alluvium and aquifer would not be disturbed.	Approximately 1,800 linear feet of alluvium and aquifer associated with Clancy Creek on the northwest side of the mine pit would be excavated and removed.	Same as Alternative 2.
	No operational verification program of L-Pit lake water quality or seepage from the tailings storage facility would be implemented.	Same as Alternative 1 for the M-Pit.	An operational verification program would be implemented to verify estimates of M-Pit lake water quality and seepage from the tailings storage facility made in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The models would be calibrated using operational data. The calibrated models would be rerun, and, if necessary, pit water or tailings storage facility leachate would be managed or treated, as appropriate.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Surface Water	The Clancy Creek channel would not be disturbed and the current flow regime in Clancy Creek would not be altered.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a combined 2,000-foot pipe and 600-foot lined channel near the mine pit.	Similar to Alternative 2, except that Clancy Creek would be routed to a constructed open-flow channel around the northwest side of the mine pit soon after commencing the M-Pit Mine Expansion. This constructed channel would be designed to mimic the existing stream channel.
	During operations, 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow would be appropriated from Clancy Creek at a point of diversion downstream of Kady Gulch. Up to 1,000 gpm (2.2 cfs) would be appropriated from Spring Creek.	Same as Alternative 1.	Same as Alternative 1.
	The Pen Yan Creek channel has been permitted for diversion but would not be disturbed in the L-Pit plan.	Approximately 3,800 feet of the existing ephemeral Pen Yan Creek channel would be covered with waste rock and the channel would be realigned.	Same as Alternative 2.
	After mining ceases, flows from Clancy Creek would not be used to fill the L-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would be used to fill the M-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would not be used to fill the M-Pit to accelerate pit lake filling.
	The concentration of sulfate in Spring Creek would temporarily increase.	The concentration of sulfate in Spring Creek would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Wetlands	There are no direct impacts to wetlands.	Mining would impact 2.63 acres of wetlands. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation. The total wetland disturbance is 4.77 acres. The total proposed migration is 5.13 acres. The proposed wetlands mitigation plan would create 3.0 acres of new wetlands to replace the 2.63 acres of wetlands impacted by the M-Pit Mine Expansion for an average replacement ratio of 1.14 to 1.	Similar to Alternative 2, except there is potential for some additional wetlands to reestablish along the constructed open-flow channel for Clancy Creek.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Wildlife	Effects resulting from altered habitats (L-Pit, waste rock storage areas, tailings storage facility), including reclaimed sites, would persist. Mining has destroyed pre-mining wildlife habitat. Some animals seem to have habituated to mine-related activity. The quality of wildlife cover in reclaimed lands has been lowered due to reduced amounts of shrubs and conifers. Some animals, however, may benefit from the increased acreage of grassland foraging habitat.	Similar to Alternative 1, except additional impacts would be additive to those that have already occurred. Impacts primarily would be additional loss of wildlife habitat mostly through expansion of the mine pit and waste rock storage areas and redisturbance of reclaimed waste rock storage acres.	Same as Alternative 2, except that limiting motorized travel in important winter and summer ranges would be beneficial to deer and elk; and donating the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation but with the requirement of using only existing building sites and reclaiming other areas would result in less impact to wildlife.
	Total area disturbed is 1,199.5 acres.	Total area disturbed is 1,452.2 acres.	Total area disturbed is 1,489.1 acres.
Fisheries and Aquatics	Short-term impact to aquatic habitat associated with appropriation of 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow in Clancy Creek at a point of diversion downstream of Kady Gulch. No long-term impacts to fisheries and aquatic resources.	Same as Alternative 1.	Same as Alternative 1.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Fisheries and Aquatics (Cont.)	The Clancy Creek stream channel would not be impacted.	Approximately 1,800 feet of Clancy Creek channel and associated aquatic habitat northwest of the M-Pit would be excavated and removed. The channel would be replaced with a combination 2,000-foot-long, 16-inch-diameter pipe and 600-foot lined channel. There would be loss of connection with stream habitat in Clancy Creek upstream of the mine pit diversion.	Clancy Creek would be routed to a constructed open-flow channel soon after commencing the M-Pit Mine Expansion and habitat would remain connected. The restored channel area would be fenced to discourage livestock grazing and other human caused channel disturbances in order to preserve habitat in the long-term. The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future.
	No loss of habitat; the flow regime in Clancy Creek channel would not altered.	A portion of Clancy Creek would be diverted into the M-Pit. There would be the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek.	Only flood events greater than the 1 in 20 year return period 24 hour storm event would be diverted to the M-Pit. No loss of habitat in Clancy Creek is anticipated.
Socioeconomics	Loss of approximately 180 full time jobs and 35 part time jobs in 2009.	Economic benefits of the mine extended 4.5 years to 2013.	Same as Alternative 2.
	Loss of about $2.5 million in annual wage income above county average wages in 2009. Loss of secondary benefits to local businesses in 2009.	Loss of jobs, income and secondary benefits mentioned in Alternative 1 would occur in 2013 rather than 2009.	Same as Alternative 2.

TABLE 5.1-1 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Socioeconomics (Cont.)	In 2009, loss of mine-generated tax revenue.	About $9.5 million more in taxes revenues would be generated through 2013 compared to Alternative 1.	Same as Alternative 2.
	Additional metals would not be extracted from the mine after 2009.	Additional metals would be extracted from the mine until 2013.	Same as Alternative 2.
	Road maintenance and recreation costs would end in 2009.	Road maintenance and recreation costs would be slightly higher than under Alternative 1.	Same as Alternative 2.
Cultural Resources	Eight previously documented historical mining sites have already been recorded and mitigated through photographic documentation.	Three sites (24JF1826, 24JF1823, and 24JF1824) have been determined "not eligible" for listing on the National Register of Historic Places and would not be adversely affected by mine operations. Site 24JF1825 has been determined "eligible."	Same as Alternative 2.

Notes:
Cont. = Continued

Consultation and Coordination

MEPA and NEPA require DEQ and BLM to consult with local, federal, and state agencies about the Proposed Action during project scoping. The agencies consulted with other federal and state agencies including the U.S. Environmental Projection Agency, the U.S. Forest Service, and FWP, local governments including Jefferson County, and with individuals and non-government stakeholders including the Jefferson Local Development Corporation, mine employees, and the general public. Agencies with review or permit authority on the Montana Tunnels project are identified on **Table 1.5-1**. The consultation process took place during scoping and follow-up discussions. Interested individuals and organizations, affected federal, state, and local agencies were invited to submit comments to DEQ and BLM. Comments were received in writing and verbally at the scoping meeting on January 6, 2005 and over the telephone.

Formal and Informal Consultation and Coordination

The Corps of Engineers agreed to be a cooperating agency for this EIS in a letter from Jean Ramer to John Schaefer of Montana Tunnels, dated November 30, 2004. The Corps of Engineers has participated in EIS preparation meetings on several occasions. Briefings and other forms of collaboration have occurred with the other agencies who have stayed involved throughout the process. For example, DEQ and BLM met with Mike Korn, Gayle Joslin, and Ron Spoon of FWP on May 26, 2005, to discuss FWP concerns about the project and possible mitigations.

In Fall of 2007 the agencies discussed the proposed project with other bureaus and divisions at Montana DEQ such as the Environmental Management Bureau, the Industrial and Energy Minerals Bureau, and the Remediation Division to identify cumulative impact concerns. The agencies also contacted the Jefferson County Planning Department, FWP, and the U.S. Forest Service offices for cumulative impacts analysis. These discussions are outlined in the cumulative effects analysis in Chapter 4.

Public Scoping

DEQ published a legal notice in local newspapers and issued a press release in September 2004 when the application was received. A news release announcing the project and the scoping meeting was published on December 15, 2004. DEQ and BLM held the scoping meeting on January 6, 2005, in Clancy, Montana. The meeting was organized to include presentations by mine and agency representatives. Participants were also given the opportunity to meet one-on-one with DEQ and BLM representatives to ask questions. The scoping process is discussed in section 1.6. About 100 people attended the scoping meeting, mostly miners and vendors.

A Notice of Intent to prepare the draft EIS was published in the Federal Register on February 22, 2005. The Notice of Intent asked that scoping comments be sent to BLM and DEQ by March 24, 2005.

In total 76 letters and emails were received during scoping from the general public, and from federal and state government agencies including EPA and FWP. The majority of the comments from the general public were from mine employees, mine contractors, and vendors who noted the positive economic impacts of mining in general, and specifically of the proposed project. The primary issues of concern identified during scoping are discussed in Section 1.7.

List of Preparers

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Jeff Blend	Socioeconomics	B.S. Economics M.S. Economics Ph.D. Agricultural Economics
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Glossary

A

Acid or acidity: An acid is a substance that produces hydrogen ions (H+) in water thereby reducing the pH of water to a value below 7. Acidity is the quality, state, or degree of being acid.

Acid base potential: The measure of a neutralizing material theoretically available to neutralize potential acid generated by ore or waste rock.

Aerobic: In the presence of oxygen.

Alaskite: A granitic rock that contains less than 5 percent of dark-colored minerals.

Alkalinity: The measurement of constituents in a water supply which determine alkaline conditions. The alkalinity of water is a measure of its capacity to neutralize acids.

Alluvium: Sediments deposited by erosional processes, usually by streams.

Andesitic: A term applied to dark-colored, fine-grained extrusive rock.

Aplite: A light-colored igneous rock characterized by a fine-grained texture.

Aquifer: A geologic formation that will yield water to a well in sufficient quantities to make the production of water from this formation feasible for beneficial use; permeable layers of underground rock or sand that hold or transmit groundwater below the water table.

Attenuation: A decrease in concentration due to physical, chemical, or biological interactions.

B

Basalt: A dark grey to black dense to fine-grained igneous rock that consists of plagioclase, augite, and magnetite.

Baseflow: Groundwater flow to a surface water body.

Basin: An aquifer or aquifer system whose boundaries are defined by surface-water divides, topographic barriers, or a structural basin and in which the aquifers are isolated from adjacent aquifers. Or the area drained by stream or river and its tributaries.

Bedrock: Consolidated rock at or beneath the earth's surface.

Beneficial use: Desirable uses that water quality should support. Beneficial uses include drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be supported.

Bentonite: A naturally occurring clay-like substance formed from the decomposing of volcanic ash. Bentonite swells greatly in the presence of water and when amended with soil reduces permeability.

Berm: A horizontal, earthen structure, often constructed on exposed slopes, which increases slope stability, redirects the flow of water or other materials, or provides a place for sloughing material to collect.

Bioaccumulation: General term describing a process by which chemicals are taken up by an organism either directly from exposure to a contaminated medium or by consumption of food containing the chemical.

Bioconcentration: A process by which there is a net accumulation of a chemical directly from an exposure medium into an organism.

Biomagnification: Result of the process of bioaccumulation and biotransfer by which tissue concentrations of chemicals in organisms at one trophic level exceed tissue concentrations in organisms at the next lower trophic level in a food chain.

Biotite: Biotite is a common mineral within the mica group, with the approximate chemical formula $K(Mg, Fe)_3Al,Si_3O_{10}(OH)_2$.

Boulder Batholith: A huge granite formation that stretches from south of Helena to north of Dillon. The Batholith was shaped by magmas shoved upwards by volcanic eruptions about 70 to 80 million years ago. Then, granite (quartz monzonite) was pushed to within a few miles of the surface before rapid cooling stopped it and caused cracks and fissures to occur. Into these cracks flowed mineralized solutions, most likely from the molten magma below, containing copper, gold, silver and other now precious metals.

Breccia: A rock composed of angular fragments of rocks or minerals in a matrix, that is a cementing material, and which may be similar or different in composition to the fragments.

Bullion: Refined gold or silver, uncoined, in the shape of bars, ingots, or comparable masses.

Butte Quartz Monzonite: Granite

Buttress: A body of material placed against a section of the tailings storage area to prevent wall failure.

C

Calcium carbonate: A common mineral with the chemical formula $CaCO_3$. The weight of $CaCO_3$ is used as a convenient unit to represent units of neutralization potential needed to neutralize an equivalent amount of acid. Neutralization potential is quantified by titration using an acid, and then again, converting proportionally to equivalent units of CaCO3.

Carbonates: The collective term for the natural chemical compounds that contain the carbonate ion CO_3^{-2}. Calcite and colomite are types of carbonate rocks. Carbonates give off carbon dioxide when treated with dilute acids. The carbonate chemical compounds are among the most widely distributed minerals in the earth's crust.

Castblasting: Blast design which utilizes the surplus explosive energy to move overburden material across the pit. A properly designed cast blast often generates less vibration than a conventional blast design.

Catchment area: Land area from which water drains toward a common watercourse in a natural basin. See Drainage area below.

Chironomidae: A family of midges in the Order Diptera. Chironomidae account for most of the aquatic invertebrates in freshwater environments.

Clastic rock: A sedimentary rock formed from mineral particles (clasts) that were mechanically transported.

Climate: Generalized weather at a given place on earth over a fairly long period; a long term average of weather.

Colluvium: Rock fragments and soil accumulated at the foot of a slope by erosion.

Combined drains. A single pipe that drains seepage from the tailings storage facility underdrain and embankment drains.

Completion: Sealing off access of undesirable water to the well bore by proper casing or cementing procedures.

Concentration: Amount of a chemical or pollutant in a particular volume or weight of air, water, soil, or other medium.

Conductivity: Measure of the ability of an aqueous solution to carry an electric current.

Cone of depression: Natural depression in the water table around a well during pumping.

Coniferous: Trees with small and waxy leaves, sometimes needles, which stay on the tree all year long. Also known as evergreen trees, they bear their seeds in cones.

Consolidation: Settling of solids because water is removed from pore spaces.

Contamination: The introduction into water of constituents that will render the water less fit for use.

Cross Contamination: Bias introduced during sampling or chemical analysis due to introduction of a substance from analytical/sampling equipment or reagents and not from the sample itself.

Cubic foot per second (CFS): The rate of discharge representing a volume of one cubic foot passing a given point during 1 second. This rate is equivalent to approximately 7.48 gallons per second, or 1.98 acre-feet per day.

D

Dam: A structure of earth, rock, or concrete designed to form a basin and hold water back to make a pond, lake, impoundment, or reservoir.

Decant stand pipe system: Pipe system that allows surface runoff water to flow though the pipes toward the south pond.

Deciduous: Trees and plants that shed their leaves at the end of the growing season.

Dendritic drainage: In hydrologic terms, the form of the drainage pattern of surface water runoff when it follows a treelike shape.

Demographics: The characteristics of a human population or part of it, especially its size, growth, density, distribution, and statistics regarding birth, marriage, disease, and death.

Detection Limit: The lowest concentration of a chemical that can be detected through laboratory analysis.

Diatreme: A breccia filled volcanic pipe formed by a gaseous explosion.

Dike: A body of rock, usually igneous (solidified magma) and often tabular in form, which cuts across other older rocks.

Discharge: The volume of water that passes a given point within a given period of time.

Dispersion: The movement and spreading of contaminants out and down in an aquifer.

Disseminated: Said of a mineral deposit (especially of metals) in which the desired minerals occur as scattered particles in the rock, but in sufficient quantity to make the deposit an ore.

Dissolve: The process by which solid particles mix molecule by molecule with a liquid and appear to become part of the liquid.

Dissolved Concentration: Mass of solute per volume of solution in a sample filtered through a filter with a 0.45 micron pore size. Groundwater quality standards in Montana are based on dissolved concentrations.

Dissolved solids: Inorganic material that is contained in water or wastes. Excessive dissolved solids make water unsuitable for drinking or industrial uses.

Diversion: A structure used to prevent water from reporting to a specific unit of land or water.

Drainage area: Of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified location. Used the same as catchment area.

Driller's well log: A log kept at the time of drilling showing the depth, thickness, character of the different strata penetrated, location of water-bearing strata, depth, size, and character of casing installed.

Drought: Generally, the term applied to periods of less than average precipitation over a certain period of time.

E

Edaphic: Of the soil, or influenced by the soil.

Elkhorn Mountain Volcanics: Volcanic rocks related to the granites of the Boulder Batholith. Volcanic rocks from sources in the Elkhorn Mountains reach as far as Choteau but the thickest deposits lie within a radius of about 60 miles from the Elkhorn Mountains.

Emergents: Erect rooted herbaceous plants that can tolerate flooded soil conditions, but not extended periods of being completely submerged, *e.g.* cattails.

Endocrine: Pertaining to hormones.

Ephemeral: A stream or portion of a stream that flows only in direct response to precipitation or snowmelt.

Erosion: The mechanical or chemical wearing away of the land surface by wind, water, ice, or other geologic agents. Erosion occurs naturally from weather or runoff but is often intensified by human land use practices.

Evaporation: The change by which any substance is converted from a liquid to a vapor.

Extrusive volcanic rocks: Volcanic rock that is extruded on the surface, such as lava.

F

Factor of Safety: A calculation defining the relationship of the strength of the resisting force on an element (C) to the demand or stress on the disturbing force (D) where Force = C/D. When F is less than 1, failure can occur.

Feldspar: A hard crystalline mineral group consisting of aluminum silicates of potassium or sodium or calcium or barium. Feldspar is expected to be an important buffering agent once mining is completed. Felspar, water, and carbon dioxide are anticipated to produce an alkaline liquid, clay, and silica as the pit fills with water. The alkalinity would buffer potential acid producing reactions.

Filter: A device used to remove solids from a mixture or to separate materials.

Flood: An overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream. It is also a relatively high flow as measured by either gage height or discharge quantity.

Floodplain: Land next to a river that becomes covered by water when the river overflows its banks.

Flow: The rate of water discharged from a source expressed in volume with respect to time.

G

Gallon: A unit of volume. A U.S. gallon contains 231 cubic inches, 0.133 cubic feet, or 3.785 liters.

Geochemistry: The study of the chemical components of the earth's crust and mantle.

Geotechnical: Pertaining to the application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the earth's crust for the solution of engineering problems. It embraces the fields of soil mechanics and rock mechanics, and many of the engineering aspects of geology, geophysics, hydrology and related sciences.

Gouge: Pulverized rock consisting of fine powder that lies along fault surfaces; gouge forms by crushing and grinding. This is also known as fault gouge.

Gravitational constant: The universal constant relating force to mass and distance in Newton's law of gravitation.

Gravelly colluvium: Gravel and rock fragments with soil that is accumulated at the foot of a slope by erosion.

Greater Yellowstone area: The high mountainous region including and surrounding Yellowstone National Park, encompassing pieces of three states.

Greenschist metamorphism: Altered rock whose green color is due to the presence of green minerals.

Groundwater: Water within the earth that supplies wells and springs; water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table.

Groundwater sink: A lowering of the natural water table surface that is created by operation of pumping wells and horizontal drains that have been drilled in the pit highwalls during mining to maintain a zone of groundwater depressurization. Groundwater flows radially toward the lowered water table in the area of a groundwater sink.

H

Hardness: Condition in water caused by dissolved salts of calcium, magnesium, and iron, such as bicarbonates, carbonates, sulfates, chlorides, and nitrates.

Head: The pressure of a fluid owing to its elevation, usually expressed in feet of head.

Hibernaculum: The roost (*e.g.*, cave, building) used by temperate zone bats in winter for hibernation; plural is hibernacula.

Highwall: The unexcavated face of exposed overburden and ore in an open pit mine.

Hydraulic conductivity: The volume of fluid that flows through a unit area of porous medium for a unit hydraulic gradient normal to that area.

Hydraulic gradient: The change in hydraulic head with direction.

Hydrogeology: A term which denotes the branch of hydrology relating to subsurface or subterranean waters; that is, to all waters below the surface.

Hydrology: The science that deals with global water (both liquid and solid), its properties, circulation, and distribution, on and under the Earth's surface and in the atmosphere through evapotranspiration or is discharged into the ocean.

Hydrostatic pressure: The pressure exerted by water at any given point in a body of water at rest.

I

Ignimbrite: A rock formed by the widespread deposition and consolidation of ash flows.

Impermeable: Material that does not permit fluids to pass through.

Impoundment: An area confined by a dam, dike, floodgate, or other barrier. It is used to collect and store water or mine tailings.

Intermittent: A stream that flows periodically.

Instrusive rock: A body of igneous rock formed by the consolidation of magma intruded into other rocks, in contrast to lavas, which are extruded upon the surface.

Invertebrates: Animals without backbones.

Irretrievable: Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a winter sports site. If the use changes, timber production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

J

Jurisdictional wetlands: An area that meets the criteria established by the U.S. Army Corps of Engineers for wetlands (as set forth in their Wetlands Delineation Manual).

K

Kinetic Tests: Geochemical tests designed to evaluate changes in sample behavior that would occur due to an extended period of weathering.

L

Lake: An inland body of water, usually larger than a pool or pond.

Leachate: Water containing contaminants which leaks from a disposal site such as a tailings impoundment or waste rock storage area. The same as seepage.

Limited equilibrium: An approach to analyze the stability of slopes that assumes that failure occurs through sliding of a block or mass along a slip surface.

Liquefaction: The process in which a solid (soil) takes on the characteristics of a liquid as a result of an increase in pore pressure and a reduction in stress. In other words, solid ground turns to jelly.

Lithology: The physical character of a rock; common examples are granite, limestone, etc.

Loggerhead Shrike: Bird about 7 inches long, hooked bill, with a gray head and back and white under parts.

Low-damage blasting: Explosive charges which are made from a mixture of chemicals that are used to break up the rock by pressure when they explode.

Lowland Creek Volcanics: These approximately 50 million year old volcanic rocks cover a large area in the general vicinity of the Boulder Batholith. They consist mostly of fine-grained, brown through red to almost white rhyolite, andesite and basalt and overlie the Boulder Batholith on an erosion surface.

M

Matrix: The natural material in which any rock fragment, crystal, pebble, fossil, etc. is embedded.

Maximum Contaminant Level: The maximum level of a contaminant allowed in water by federal law.

Maximum Design Earthquake (MDE): Maximum level of ground motion for which the structure (wall) is designed or evaluated.

Mean: Arithmetic average.

Median: The number dividing the upper half of a sample population from the lower half. The median can be found by arranging all observations from lowest value to highest value and selecting the middle value.

Mesic: Characterized by or adapted to a moderately moist habitat.

Metal Mobility: The ability of metals to leach out of rock materials.

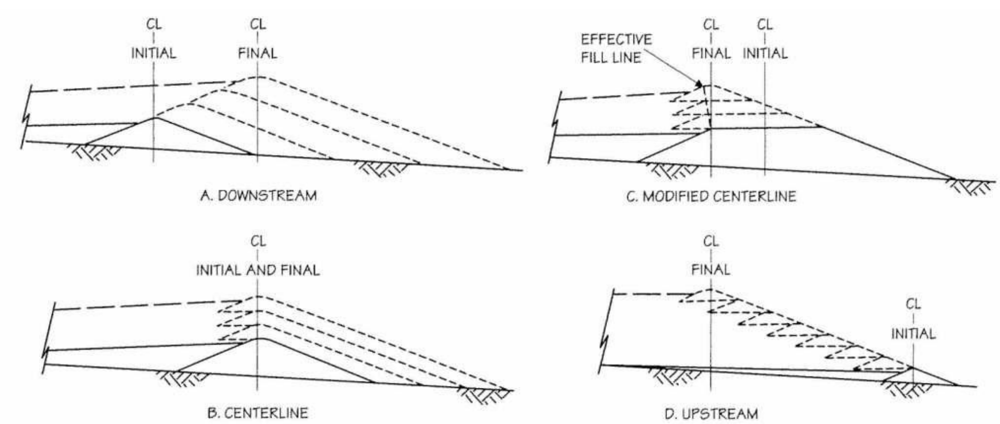
Micromhos per centimeter: Usual units for the measurement of conductivity.

Migration: The movement of contaminants, water, or other liquids through porous and permeable rock.

Milligrams per liter: This measure, used to quantify the concentration of pollutants in water, is equivalent to parts per million.

Mitigation: A measure used to reduce impacts by (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Modified centerline: One of four ways to construct embankments. See below.



(Norman and Raforth 1998)

Montane forest: Natural forest with greater than 30% canopy cover, located in the lower elevations of mountains and characterized by shallow, rock, well drained soil.

Myotis: Genus for the “mouse-eared” bat.

N

Natural flow: The rate of water movement past a specified point on a natural stream, or under existing hydrologic conditions.

Neotropical migrant: Any bird species that breeds in North America and spends the nonbreeding season south of the Tropic of Cancer.

Nephelometric turbity unit: A measurement unit of the clarity of water, dependent on the amount of suspended matter.

O

One-Way Analysis of Variance: Statistical method used to determine whether an observed difference is statistically significant as opposed to being due to chance as influenced by sample variability.

Operating Basis Earthquake (OBE): The earthquake that the structure (walls) must safely withstand with no damage.

Outfall: The place where a discharge occurs.

Oxidation: The process of combining with oxygen; or the process by which electrons are removed from atoms or ions.

P

Palustrine: Fresh water wetlands dominated by trees, shrubs, emergents, mosses or lichens.

Palustrine forest (PFO): A wetland class where the soil is saturated and often inundated, and woody plants taller than 20 feet form the dominant cover. Water tolerant shrubs often form a second layer beneath the forest canopy, with a layer of herbaceous plants growing beneath the shrubs.

Palustrine scrub-shrub (PSS): A wetland class dominated by shrubs and woody plants that are less than 20 feet tall. Water levels in shrub swamps can range from permanent to intermittent flooding.

Passerine bird: Of or relating to birds of the order Passeriformes, which includes perching birds and songbirds such as the jays, blackbirds, finches, warblers, and sparrows.

Pegmatite: An exceptionally coarse-grained igneous rock, with interlocking crystals.

Percolation pond: An unlined pond that allows water to seep through the bottom.

Perennial stream: A stream that flows all year round.

Periphyton: Organisms that live attached to underwater surfaces.

Permeability: The ability of a water bearing material to transmit water.

pH: Numeric value that describes the intensity of the acid or basic (alkaline) conditions of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate the presence of acids and greater than 7.0 the presence of alkalis (bases). Technically speaking, pH is the logarithm of the reciprocal (negative log) of the hydrogen ion concentration (hydrogen ion activity) in moles per liter. The pH scale is logarithmic, which means that each unit from 0 to 14 increases by an order of magnitude.

Phenocrysts: A term for large crystals or mineral grains floating in the matrix of an igneous rock containing larger crystals in a fine-grained matrix.

Piezometers: Is a small diameter water well used to measure the hydraulic head of groundwater in aquifers.

Plagisoclase: A group of minerals containing a mixture of sodium and calcium feldspars.

Planar shear instability: Large, thin body of rock or land that is unstable and could possibly break from the main body of rock or land.

Plume: The area taken up by contaminant(s) in an aquifer.

Pond: A body of water usually smaller than a lake and larger than a pool either naturally or artificially confined.

Porphyry: An igneous rock that contains conspicuous larger crystals in a fine-grained matrix.

Potable: Suitable, safe, or prepared for drinking.

Precipitate: A solid which has formed from an aqueous solution. (*e.g.*, iron from groundwater precipitates to a rust colored solid when exposed to air).

Priority date: The date of establishment of a water right.

Prism surveying: Utilize survey prisms mounted on monuments in areas that may suffer surface displacement. Survey measures ground surface motion in attempt to determine what is occurring at depth with the rock/soil.

Probable maximum precipitation: The precipitation that may be expected from the most severe combination of critical meteorologic conditions, and that is reasonably possible in an area as found in the National Weather Service Hydrometeorological Reports.

Pump: A device which moves, compresses, or alters the pressure of a fluid, such as water or air, being conveyed through a natural or artificial channel.

Pyrite: Iron disulfide (FeS_2), the most common sulfide mineral, commonly known as "fool's gold."

Q

Quartz Latite: An igneous, volcanic rock containing 5-20% quartz.

R

Reagent: A chemical agent which is used to adhere to the large mineral, which then rises to the top of the flotation cells, where it can be collected.

Recharge: Refers to water entering an underground aquifer.

Runoff: Surface water entering ponds, ditches, streams, or reservoirs from upgradient land surfaces.

S

Sediment: Soil particles, sand, and minerals washed from the land into aquatic systems as a result of natural and human activities.

Sedimentation pond: Basin or pond that allows solid materials in suspension to settle.

Seep: A spot where fluid or water oozes slowly to the surface and often forms a pool.

Sinuosity: The amount of directional change in a stream channel as it flows downstream.

Slimes: The finest fraction of tailings.

Soil erosion: The process by which soil is removed from one place by forces such as wind, water, and construction activity, and is eventually deposited at some new place.

Specific conductance: A measure of the ability of water to conduct an electrical current.

Spillway: The channel or passageway around or over a dam through which excess water is directed.

Spring: An issue of water from the earth; a natural fountain; a source of a body or reservoir of water.

Standard Deviation: A statistic that describes the spread of the values contained in a set of data. If the data points are close to the mean, then the standard deviation is small. Conversely, if many data points are far from the mean, then the standard deviation is large. If all the data values are equal, then the standard deviation is zero.

Static: Fixed or stable condition.

Static Tests: Geochemical tests designed to assess acid generating behavior based solely on the relative concentrations of acidic and neutralizing minerals present in a sample.

Stream: A general term for a body of flowing water.

Streamflow: The discharge that occurs in a natural channel.

Sulfide: Refers to chemical compounds containing sulfur in its lowest oxidation number of −2. Oxidation of common metal sulfide (such as the iron sulfides: pyrite and marcasite) creates acidic leachate.

Surface impoundment: An indented area in the land's surface, such a pit, pond, lagoon, or tailings storage facility, which holds water and other materials behind a retaining structure.

Surface water: Water that flows in streams and rivers and in natural lakes, in wetlands, and in reservoirs constructed by humans.

T

Talus slope: A slope caused by an accumulation of angular rock debris at the base of a cliff or steep slope that was produced by physical weathering.

Taxa: A group of similar animals.

Time domain reflectometer: A piece of equipment which sends a radar pulse down a cable pair to detect an impedance mismatch or discontinuity. Used to monitor rock mass response to underground and surface mining

Total concentration: Mass of solute per volume of solution in an unfiltered sample. Surface water quality standards in Montana are based on the total recoverable digestion procedure.

Total dissolved solids: The sum of all inorganic and organic particulate material in a water sample.

Trace metals: Metals present in minor amounts in soil or rock.

Transmissivity: Refers to the rate at which an aquifer allows the transmission of water. Transmissivity is directly proportional to aquifer thickness and the hydraulic conductivity.

Tributary: A stream that contributes its water to another stream or body of water.

Tuffaceous: Composed of more than 50 percent rock from an explosive or aerial ejection of ash, fragments, and glassy materials from a volcanic vent.

U

Unconfined: An aquifer whose upper boundary is the water table.

Unconsolidated: Naturally-occurring uncemented accumulations such as alluvium, soil, gravel, clay, and overburden.

Underdrain: A concealed drain with openings through which the water enters and is directed in a controlled manner.

Understory: The vegetation layer between the overstory or canopy and the groundcover of a forest community, usually formed by shade-tolerant species or young individuals of emergent species. May also refer to the groundcover if no tree or shrub layer is present.

Unsaturated: The condition when the porosity is not filled with water.

V

Volcanic: A geologic layer made of materials derived from a volcano.

Volcaniclastic: A term describing rock composed of volcanic fragments.

W

Water hardness: The overall mineral content of water. This content usually consists of metal ions, mainly calcium (Ca) and magnesium (Mg) in the form of carbonates, but may include several other metals as well as bicarbonates and sulfates.

Water quality criteria: Scientifically derived ambient limits developed and updated by EPA, under section 304(a)(1) of the Clean Water Act, or by DEQ in publication DEQ-7.

Water table: Level below the earth's surface at which the ground becomes saturated with water; the surface of an unconfined aquifer which fluctuates due to seasonal precipitation.

Weathering: The process of breaking down rocks, soils and their minerals through direct contact with the atmosphere.

Wedge Failure: A failure in soil or geologic materials involving the sliding of a wedge along the line of intersection of two planar discontinuities.

Well: Any artificial excavation constructed for the purpose of exploring for or producing ground water.

Wetland: Area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year, such as a bog, pond, fen, estuary, or marsh.

X

Xanthates: Any of a class of organic salts formed by treatment of an alcohol with carbon disulfide in the presence of an alkali. Alkali-metal xanthates are used as ore flotation collectors.

Y

Yield: The quantity of water expressed either as a continuous rate of flow (cubic feet per second, etc.) or as a volume per unit of time.

Acronym List

Apollo Gold	Apollo Gold Corporation
Aq-a	Acute aquatic life water quality standard
Aq-c	Chronic aquatic life water quality standard
BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
$CaCO_3$	Calcium carbonate
cfs	Cubic feet per second
CFR	Code of Federal Regulations
Corps of Engineers	U.S. Army Corps of Engineers
dBA	A-weighted decibels
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
DSL	Montana Department of State Lands
EA	Environmental Assessment
e.g.	for example
EGI	Elkhorn Goldfields, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EPT	*Ephemeroptera*, *Plectoptera*, and *Trichoptera*
ft	foot, feet
ft/day	feet per day
FTE	Full-time equivalents
FWP	Montana Fish, Wildlife, and Parks
GIS	Geographic Information System
gpm	Gallons per minute
L_{dn}	day-night average noise level
L_{eq}	equivalent noise levels
LTA	Land Type Analysis
MCA	Montana Code Annotated
MDE	Maximum Design Earthquake
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act

MMRA	Metal Mine Reclamation Act
mg/L	Milligrams per Liter
MPDES	Montana Pollutant Discharge Elimination System
MTNHP	Montana Natural Heritage Program
Montana Tunnels	Montana Tunnels Mining, Inc.
NA	Not applicable
ND	No data
NCDE	Northern Continental Divide Ecosystem Recovery Zone
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NRIS	Natural Resource Information System
OBE	Operating Basis Earthquake
PEMA	Palustrine emergent (temporarily flooded)
PSSA	Palustrine scrub-shrub (temporarily flooded)
PSSC	Palustrine scrub-shrub (seasonally flooded)
PFOC	Palustrine forested (seasonally flooded)
SC	Specific conductivity
s.u.	Standard units
TSS	Total suspended solids
TDS	Total dissolved solids
TR	Total recoverable
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WESTECH	Western Technology Environmental Services, Inc.
µmhos/cm	Micromhos per centimeter

References

Adams, R.A. 2003. *Bats of the Rocky Mountain West: Natural History, Ecology, and Conservation*. University of Colorado Press. Boulder, CO. 289 pp.

Anderson M.P., and W.W. Woessner. 1992. *Applied Groundwater Modeling, Simulation of Flow, and Advective Transport*. Academic Press. 381 pp.

Anderson, Paul and Lyn Fredlund. 1984. Inventory and Assessment of Cultural Resources: Montana Tunnels Project, Jefferson County, Montana. GCM Services, Inc, for Centennial Minerals, Inc.

Apollo Gold Corporation. 2004. Montana Tunnels Mine Geology and Mineralization. Unpublished company report. 5p and figures. March 28.

Apollo Gold Corporation. **2004a**. "Reports third quarter results." November 11. Available online at: http://www.apollogold.com/apollodir1/news.htm.

Apollo Gold Corporation. 2005. "Apollo Gold updates proven and probable reserves." Available online at: http://www.apollogold.com/apollodir1/news/a_news/news031605c.pdf.

Apollo Gold Corporation. 2006. "Places Montana Tunnels Mine on Care and Maintenance." May 12. Available online at: http://www.apollogold.com/apollodir1/news.htm

Apollo Gold Corporation. 2007. "Production restarts at Montana Tunnels Mine." Available online at: http://www.apollogold.com/apollodir1/news/a_news/news030207.pdf.

Bahls, L., R. Bukantis and S Tralles. 1992. Benchmark biology of Montana reference streams. Montana Department of Health and Environmental Science, Water Quality Bureau, Helena, MT.

Bear, B., T. McMahon, and A. Zale. 2005. Thermal Requirements of Westslope Cutthroat Trout. Department of Ecology, Fish and Wildlife Program, Montana State University, Bozeman, MT.

Becraft, G.E., D.M. Pinckney, and S. Rosenblum. 1963. *Geology and Mineral Deposits of the Jefferson City Quadrangle, Jefferson and Lewis and Clark Counties, Montana*. U.S. Geological Survey Professional Paper 428. 101 p.

Berglund, J. 1999. *MDT Montana wetland assessment method.* Prepared for Montana Department of Transportation and Morrison-Maierle, Inc. by Western EcoTech, Helena, MT. 18 p. + app.

Booth, W.E. and J.C. Wright. 1966. *Flora of Montana*. Department of Botany and Microbiology, Montana State University, Bozeman, MT.

Buol, S.W, F.D. Hole, and R.J. McCracken. 1973. *Soil Genesis and Classification*. Iowa State University Press, Ames, IA.

Call and Nicholas Inc. 1995. Letter regarding Slide in Southwest Portion of Montana Tunnels Pit. August.

Carey, C. and C. Bryant. 1995. Possible interrelations among environmental toxicants, amphibian development, and decline of amphibian populations. *Environmental Health Perspectives*. Volume 103, Supplement 4. May. Pages 13-17.

Caywood, Janene. 2007. Cultural Resource Specialist with CRCS personal communication with Gary Sturm, Project Engineer, Tetra Tech EM, Inc., Helena, MT.

Claar, J. J., N. Anderson, D. Boyd, M. Cherry, B. Conard, R. Hompesch, S. Miller, G. Olson, H. Ihsle Pac, J. Waller, T. Wittinger, H. Youmans. 1999. "Carnivores." Pages 7.1– 7.63 *in* Joslin, G. and H. Youmans, coordinators. *Effects of recreation on Rocky Mountain wildlife: A Review for Montana*. Committee on Effects of Recreation on Wildlife. Montana Chapter of The Wildlife Society. 307pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. Biological Services Program; U.S. Fish and Wildlife Service FWS/ OBS-79/31. USGPO. Washington, D.C. 103 pp.

Culwell, L.D., K.L. Scow and L.A. Larsen. 1984. Vegetation Inventory of the Montana Tunnels Study Area, Jefferson County, Montana. Unpublished technical report prepared for Centennial Minerals, Inc., by Western Technology and Engineering, Inc., Helena, MT. 87 pp.

Dobkin, D. S. 1994. *Conservation and Management of Neotropical Migrant Landbirds in the Northern Rockies and Great Plains*. University of Idaho Press. Moscow, ID.

Dollhopf, D.J. 1990. Assessment of Potential Acid Producing Characteristics of Tailings Material from Montana Tunnels Mining. Montana State University Reclamation Research Unit.

Dorn, R.D. 1984. *Vascular Plants of Montana*. Mountain West Publishing, Cheyenne, WY. 176 pp.

Eisler, R. 1985. Cadmium hazards to fish, wildlife, and invertebrates: A synoptic review. *Contaminant Hazard Reviews*, Report Number 2. Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, Laurel, MD 20708. July. Available online at: http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm

Eisler, R. 1988. Lead hazards to fish, wildlife, and invertebrates: A synoptic review. *Contaminant Hazard Reviews*, Report Number 14. Patuxent Wildlife Research Center, U.S. Fish and Wildlife Service, Laurel, MD 20708. April. Available online at: http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm

Environmental Laboratory. 1987. *Corps of Engineers wetland delineation manual*. Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Farmer, P. J., D. J. Bergeron, K. L. Scow, and S. B. Heath. 1984. Montana Tunnels Project Baseline Terrestrial Wildlife Study. Unpublished. Technical Report by Western Technology and Engineering, Inc. (WESTECH) for Centennial Minerals, Inc. Helena, MT.

Farmer, P. J., S. B. Heath, D. J. Bergeron, and K. L. Scow. 1985. Montana Tunnels Project Baseline Terrestrial Wildlife Survey. Unpublished Technical Report by WESTECH for Centennial Minerals, Inc. Helena, MT.

Fauntleroy, Jan. 2007. USFS email regarding burning and grazing projects in the Montana Tunnels Area. November 26.

Feigley, P., Ph.D. 2007. Draft Biological Evaluation and Biological Assessment for Terrestrial Wildlife Species, Montana Tunnels Mine Expansion. Prepared for Bureau of Land Management. April 16.

Ferguson, David. 2003. A Class III Cultural Resources Inventory of the Apollo Gold/Montana Tunnels Proposed Permit Expansion Area, Jefferson County, MT. GCM Services, Inc., for Apollo Gold, Inc.

Fogle, Vern. 2004 Montana Department of Revenue, personal communication with Jeff Blend, October 29.

Foresman, K. R. 2001. *The Wild Mammals of Montana*. American Society of Mammalogists. Special Publication No. 12.

Germain, D., M. Tasse, and C. Dufour. 2000. A Novel Treatment for Acid Mine Drainage, Using a Wood-Waste Cover Preventing Sulfide Oxidation. In Proceedings from the 5th International Conference on Acid Rock Drainage, Volume II. p. 987-998.

Giddings, Brian. 2005. Montana Fish, Wildlife and Parks, Statewide Furbearer Coordinator, personal communication with Pete Feigley, August 2005.

Griffith, J. 1988. Review of competition between cutthroat and other salmonids. American Fisheries Society Symposium, 4: 134-140.

Harp, Duane. 2006. Decision Memo Clancy Unionville Grazing Allotments Reauthorization. USDA Forest Service Northern Region, Helena National Forest. January 23.

Harrington, Neil. 2007. Montana Department of Environmental Quality Email to Alicia Stickney, Tetra Tech, regarding open cut mining projects in the Montana Tunnels area. October 15.

Hart, M. M., W. A. Williams, P. C. Thornton, K. P. McLaughlin, C. M. Tobalske, B. A. Maxell, D. P. Hendricks, C. R. Peterson and R. R. Redmond. 1998. Montana atlas of terrestrial vertebrates. Unpublished report, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Hilderbrand, R. H. and J. Kershner. 2000. Conserving inland trout in small streams: How much stream is enough? *North American Journal of Fisheries Management*. 20: 513-520.

Horan, D.L., J.L. Kershner, C.P. Hawkins, and T.A. Crowl. 2000. Effect of habitat area and complexity on Colorado River cutthroat trout density in Uinta mountain streams. Transactions of the American Fisheries Society 129: 1250–1263.

Hornocker, M. G. and H. S. Hash. 1981. Ecology of the Wolverine in Northwestern Montana. *Canadian Journal of Zoology* 59: 1286-1301.

James, S.M., E.E. Little, and R.D. Semlitsch. 2005. Metamorphosis of two amphibian species after chronic cadmium exposure in outdoor aquatic mesocosms. *Environmental Toxicology and Chemistry* 24(8): 1994–2001. Available online at: http://www.biosci.missouri.edu/semlitsch/research/pubs/James-etal2005.pdf

Jefferson County. 2003. "Jefferson County Growth Policy, adopted June 18." Available online at www.co.jefferson.mt.us

Joslin, G. 2003. Aerial Survey Results from the Montana Tunnels Mine Vicinity. Letter with attachments. Montana Fish, Wildlife, and Parks, Helena Area Resource Office. May 30.

Joslin, G. 2004. Aerial Survey Results from the Montana Tunnels Mine Vicinity. Letter with attachments. Montana Fish, Wildlife and Parks, Helena Area Resource Office. June 25.

Joslin, G. 2005. Area Biologist personnel communication with H. Peter Feigley, Wildlife Biologist. March 21.

Kiely, C. 2007. Archeologist with Butte Field Office, Bureau of Land Management, personal communication with Dan Buffalo, Project Manager, Tetra Tech EM, Inc., Helena, MT. May 22.

Kitco. 2007. Kitco – Gold Precious Metals Web Site. Available on line at: http://www.kitco.com/. Accessed in March 2007.

Kitcometals. 2007. Kitco – Base Metals Web Site. Available on line at: http://www.kitcometals.com/. Accessed in March 2007.

Koehler, G.M. and K. B. Aubry. 1994. Lynx. Pages 74-98 in L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski. 1994. American marten, fisher, lynx, and wolverine in the western United States. U.S. Forest Service General Technical Report RM-254. Available online at: http://www.fs.fed.us/rm/pubs_rm/rm_gtr254.html

Kunz, T.H. and R.A. Martin. 1982. *Plecotus townsendii*. Mammalian Species. No. 175. Pages 1-6.

Lenard, S., J. Carlson, J. Ellis, C. Jones, and C. Tilly. 2003. P.D. Skaar's Montana Bird Distribution, 6th Edition. Montana Audubon, Helena, MT.

LeMieux, P. 2006. Montana Tunnels, email correspondence, August.

Lewis and Clark County. 2004. "Lewis and Clark County Growth Policy," adopted February 15, 2004, Lewis and Clark County Planning Department.

Loucks, D.P. 1981. *Water Resources Planning and Analysis*. Prentice Hall, Inc. Englewood Cliffs, NJ.

Mackay, R.J. 1992. Colonization by lotic macroinvertebrates: A review of processes and patterns. *Canadian Journal of Fisheries and Aquatic Sciences*. 49(3): 617-628.

McCullough, Warren. 2007. Personal Communication between Warren McCullough, DEQ, and Alicia Stickney, Tetra Tech, regarding small miners and exploration projects in Montana Tunnels area. October 12.

McGuire, D.L. 1999. Clark Fork River Macroinvertebrate Community Biointegrity. Prepared for the Montana Department of Environmental Quality.

Miller, M.P. 2003. Letter from M.P. Miller (Data Assistant, Montana Natural Heritage Program) to Patrick Farmer (Wildlife Biologist, WESTECH). June 26.

Montana Department of Agriculture. 2006. Montana Noxious Weeds List. May 24.

Montana Department of Environmental Quality (DEQ). 2006a. Montana Numeric Water Quality Standards. Circular DEQ-7 Montana Numeric Water Quality Standards. February.

DEQ. 2006b. Framework Water Quality Restoration Plan and Total Maximum Daily Loads (TMDLs) for the Lake Helena Watershed Planning Area: Volume II – Final Report. Prepared by the U.S. Environmental Protection Agency, Montana Operations Office with Technical Support from Tetra Tech, Inc. and PBS&J. August 31. Helena, MT. 61 pp. Available online at: http://deq.mt.gov/wqinfo/TMDL/Lake%20Helena%20Vol2/Lake%20Helena%20Volume%20II%20Main%20Document%20Low%20Res.pdf. (Accessed June 5, 2007).

Montana Department of Labor and Industry. 2005. "Local Area Profile." Research and Analysis Bureau. (Available online at http://www.ourfactsyourfuture.org/cgi/databrowsing/localAreaProQSSelection.asp?menuChoice=localAreaPro).

Montana Fish, Wildlife and Parks (FWP). 1999. Montana elk winter ranges, summer ranges, calving areas, and migration areas: GIS layer and metadata, updated 2003 & 2004. Montana Fish, Wildlife & Parks Information Services Unit. Accessed online at http://fwp.state.mt.us/insidefwp/GIS/metadata/elk99.htm, September 19, 2005.

FWP. 2003. Final Environmental Impact Statement, Montana Wolf Conservation and Management. Helena, MT.

FWP. 2005. Scoping comments submitted to Montana Department of Environmental Quality, February 22.

Montana Department of State Lands (DSL). 1985. Draft Environmental Impact Statement, Montana Tunnels Project. Helena, MT.

DSL. 1986. Final Environmental Impact Statement, Montana Tunnels Project. Helena, MT. January.

Montana Department of Transportation. 2001. Traffic Noise Analysis and Abatement: Policy and Procedure Manual. June.

Montana Natural Heritage Program (MTNHP). 2004. Plant index. Accessed online at: http://nhp.nris.state.mt.us/plants/index.html

MTNHP. 2005. Animal guide. Accessed online, March 20, at: http://nhp.nris.state.mt.us/animalguide/

MTNHP. 2005a. Element Occurrence Records for species of special concern, requested June 2005.

Montana Partners in Flight. 2000. Bird Conservation Plan: Version 1.0 – Jan. 2000. Accessed online, March 22, 2005, at: http://biology.dbs.umt.edu/landbird/mbcp/mtpif/priority.htm

Montana State University and U.S. Department of Agriculture (USDA), Soil Conservation Service. 1980. Geologic Parent Materials of Montana Soils. Bulletin No. 721. November.

Montana Tunnels Mining, Inc. (Montana Tunnels). 2007. M-Pit Mine Expansion Application Last Revised in 2007. The revised application includes the following original documents and updates:

Information Sources

- Apollo Gold. 2004. (http://www.apollogold.com/Apollo_Gold/RIGHT/news/news031605C.htm **)**
- Apollo Gold. 2004. Montana Tunnels Mine Geology and Mineralization. Unpublished company report. 5pp and figures. March 28, 2004.
- M-Pit Mine Expansion Application. July 16, 2004.
- Apollo Gold, 2004. Hard Rock Operating Permit, Volume 2, Updated General Operating Plan and Reclamation Plan. Revision 1. November.
- Operating Plan May 18, 2007 – Current Plan of Operations, L-Pit
- Reclamation Plan May 15, 2007 – Current Reclamation Plan, L-Pit
- Mine Closure Plan May 15, 2007 – Closure Plan for Current Operating Plan
- Minor Permit Revision 05-001, Southeast Pit highwall Layback Ramp Remediation, December 20, 2005
- Annual Progress Report for Operating Permit #00113 - 2004 - Montana Tunnels, March 21, 2005
- Annual Progress Report for Operating Permit #00113 - 2005 - Montana Tunnels, March 20, 2006
- Technical Report - Montana Tunnels Mine, March 30, 2007 http://www.apollogold.com/apollodir1/news/MtTunnels_TechnicalReport_2007.pdf

Supplemental Reports

- Hydrometrics, Inc. 1993. Characterization of Baseline Groundwater Quality in Homestake Gulch. September 29.
- Hydrometrics, Inc. 2003. Memorandum re: October 2002 Pen Yan Creek Investigation, Bill Thompson and Mark Walker to John Schaefer. January.

- Hydrometrics. 2004. Report #6, Pen Yan Creek Surface Water Investigations, January 3, 2004.
- Hydrometrics. 2004. 2003 Soil Survey of Dump and Pit Expansion Areas, March, 2004.
- Hydrometrics, Inc., 2005. 2004 Annual Water Resources Monitoring Report, Montana Tunnels Mining, Inc., Jefferson County, Montana. March.
- Hydrometrics, Inc. 2006. 2006 Annual Water Resources Monitoring Report for Montana Tunnels Mining, Inc., Jefferson County, Montana. March.
- Knight Piésold, Ltd. 1993. Report on Tailings Area Expansion, Volume I of II. August.
- Knight Piésold, Ltd. 1993. Montana Tunnels Project, Tailings Disposal Facility, 1993 Wick Drain Program. December.
- Knight Piésold. 1998. Report on Hydrogeological and Slope Stability Assessment of Northwest Pit Area. May.
- Knight Piésold. 2001. Post-Closure Tailings Facility Water Quality Model. February 2001.
- Knight Piésold. 2001. Apollo Gold Corporation, Montana Tunnels Mine, Open Pit Flooding and Water Quality Modeling. March 13, 2001; Revision September 16, 2001.
- Knight Piésold. 2001. Report on Stability Assessment for On-Going Tailings Deposition, October 19, 2001.
- Knight Piésold. 2004. Report #4, Report on Tailings Facility Expansion and Embankment Stability, June 24, 2004.
- Knight Piésold. 2004. Report #1, Clancy Creek Diversion for Open Pit Expansion, June 30, 2004.
- Knight Piésold. 2004. Report #2, Updated Filling Model for M-Pit, July 8, 2004.
- Knight Piésold. 2004. Report #3, Updated Water Quality for Post-closure Open Pit Lake, July 12, 2004.
- Knight Piésold. 2004. Report #5, Closure of Tailings Disposal Facility, July 8, 2004.

- Knight Piésold. 2004. Montana Tunnels Mining, Inc., Updated Filling Model for M-Pit for Montana Tunnels Mine Expansion Amendment. July 8, 2004.
- Knight Piésold. 2004. Montana Tunnels Mine, Updated Water Quality for Post-closure Open Pit Lake. Letter Report to Mr. John Schaefer, Montana Tunnels Mining, Inc., Jefferson City, Montana. July 14, 2004.
- Knight Piésold. 2005. Assessment of East Slope Remediation Options, Ref. No. VA101-19/14-2, November 30, 2005.
- Knight Piésold Ltd., 2006. Montana Tunnels Mining Inc., Montana Tunnels Mine, Stability of Clancy Creek Closure Channel; December 15.
- Montana Tunnels. 2004. Report #9, Topsoil Balance, Mine Expansion Amendment, June 2004.
- Montana Tunnels. 2004. Report #10, M-Pit Waste Rock Storage Area Construction Plan, June, 2004.
- WESTECH. 1990. Montana Tunnels Revegetation Monitoring. July, 2004.
- WESTECH. 1991. Montana Tunnels Revegetation Monitoring. July, 2004.
- WESTECH. 2004. Report#12, Vegetation Inventory Montana Tunnels Mine Expansion, July, 2004.
- WESTECH. 2004. Report #13, Wetlands Delineation, July, 2004.
- WESTECH. 2004. Report #14, Aquatics Report, July, 2004.
- WESTECH. 2004. Report #15, Fish Report, July 2004.
- WESTECH. 2004. Report #16, Wildlife Report, July 2004.
- WESTECH. 2006. Response to comments, Montana Tunnels Mine expansion, Jefferson County, Montana. May 2006.
- WESTECH. 2007. Montana Tunnels M-Pit Mine Expansion Conceptual Compensatory Wetlands Mitigation Plan for Clancy Creek. February.

Responses to Proposed Action Review

- Response to 1st Deficiency Review Comments Rev 0 - Submitted on March 24, 2005
- Response to 1st Deficiency Review Comments Rev 0, Supplement 1- Submitted on April 28, 2005

- Response to 1st Deficiency Review Comments Rev 0, Supplement 1a - Submitted on May 9, 2005
- Response to 1st Deficiency Review Comments Rev 0, Supplement 2 - Submitted on May 26, 2005
- Response to 1st Deficiency Review Comments Rev 0, Supplement 3 - Submitted on June 30, 2005
- Response to 1st Deficiency Review Comments Rev 0, Supplement4 - Submitted on June 14, 2005
- Response to 1st Deficiency Review Comments Rev 0, Supplement 5- Submitted on September 10, 2005
- Response to 2nd Deficiency Review Comments Rev 1- Submitted on November 2, 2005

Montana Water Resources Board. 1982. "Handy Water Equivalents" summary card. Helena, MT.

Mueggler, W.F. and W.L. Stewart. 1980. Grassland and Shrubland Habitat Types of Western Montana. USDA Forest Service General Technical Report INT-66. Intermountain Forest and Range Experiment Station, Ogden, UT. 154 pp.

Naisha, K. 1998. Letter to Len Walch with Montana Fish, Wildlife, and Parks on results of genetic sampling of westslope cutthroat trout in upper Clancy Creek. University of Montana, Missoula, MT. Results reported at: http://maps2.nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd=INST

Norman, David K. and Raforth, Robert L. 1998. Innovations and Trends in Reclamation of Metal-Mine Tailings in Washington. *Washington Geology* 26(2/3): 30. September.**Novinger, D.C. and F.J. Rahel. 1999.** Exploring competitive mechanisms that allow nonnative brook trout to displace native cutthroat trout in a Rocky Mountain stream. American Fisheries Society 129th Annual Meeting Abstracts. Charlotte, NC.

NPA Data Services, Inc. 2004. "Montana Population Projections." February.

Ohmart, R.D. and B.W. Anderson. 1988. Riparian habitats. Pages 169-199 in A.Y. Cooperrider, R.J. Boyd, and H.R. Stuart (eds) Inventory and monitoring of wildlife habitat. U.S. Department of the Interior, Bureau of Land Management Service Center. Denver, CO. 858 pp.

O'Neill, Patty. 2004. Treasurer of Jefferson County personal communication with Jeff Blend, DEQ Economist, Helena, MT. December 30.

Pfister, R.D., B.L. Kovalchik, S.F. Arno and R.C. Presby. 1977. Forest Habitat Types of Montana. USDA Forest Service Gen. Technical Rept. INT-34. Intermountain Forest and Range Experiment Station, Ogden, UT. 174 pp.

Pierce, W.G. 1992. Reclamation of sulphide tailings using municipal solid waste compost: literature review and recommendations. CANMET, Ottawa, MEND Project 2.25.2(a).

Ramey, Bonnie. 2004. Memorandum. Jefferson County Clerk and Recorder. July 12.

Reice, S.R. 1985. Experimental disturbance and the maintenance of species diversity in a stream community. *Oecologia*. 67(1): 90-97.

Rieman, B.E., D.C. Lee, J.D. McIntyre, C.K. Overton, and R. Thurow. 1993. Consideration of extinction risks for salmonids. USDA Forest Service, Fish Habitat Relationships Technical Bulletin 14.

Roby, R.N., W.C. Ackerman, F.B. Fulkerson, and F.A. Crowley. 1960. "Mines and Mineral Deposits (except fuels), Jefferson County, Montana." Montana Bureau of Mines and Geology Bulletin 16. 122 pp.

Roe, A.N., K.G. Poole, and D.L. May. 1999. A review of lynx behavior and ecology and its relation to ski area planning and management. Unpublished Report, Iris Environmental Systems. Calgary, Alberta, Canada. 67 pp.

Schaefer, John. 2004. John Schaefer, Montana Tunnels Mining, Inc., email communication with Jeff Blend, DEQ Economist, Helena, MT. December 13.

Schaefer, John. 2005a. Montana Tunnels Environmental Manager, Personal Communication with Patrick Plantenberg, DEQ. October 4.

Schaefer, John. 2007. John Schaefer, Montana Tunnels Mining, Inc., email communication with Jeff Blend, DEQ Economist, Helena, MT. March 8.

Schroeder, P.R. and others. 1984. *The Hydrologic Evaluation of Landfill Performance (HELP) Model*. EPA/530-SW-84-009 and EPA/530-SW-84-010. Washington, DC.

Sillitoe, R.H., G.L. Grauberger, and J.E. Elliot. 1985. A Diatreme-Hosted Gold Deposit at Montana Tunnels, Montana. *Economic Geology* 80: 1707-1721.

Smedes, H.W. 1962. Lowland Creek Volcanics, an upper Oligocene formation near Butte, MT. *Journal of Geology* 70: 255-266.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. Field and Laboratory Methods Applicable to Overburdens and Minesoils. Industrial Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency.

Sonoran Institute. 2003. "Population, Employment, Earnings, and Personal Income Trends." Sonoran Institute, Economic Profiling System: Jefferson County, MT.

Sonoran Institute. 2003a. "Population, Employment, Earnings, and Personal Income Trends." Sonoran Institute, Economic Profiling System: Lewis and Clark County, MT.

Spoon, R. 2004. Letter dated July 7 to Pat Farmer with WESTECH Environmental Services, Inc. RE: Clancy Creek/Kady Gulch Fishery Sampling in 2001 and 2003. Montana Department of Fish, Wildlife and Parks, Helena, MT.

Spoon, Ron. 2007. Personal Communication between Ron Spoon, Montana FWP, and Kathie Roos, Tetra Tech, regarding creeks in Montana Tunnels area and fish projects. October 17.

Statistical Package for the Social Sciences (SPSS) Inc. 1997. SigmaStat for Windows Version 2.03.

Stepper, Harold. 2007. Personal Communication between Harold Stepper, Jefferson County Planner, and Alicia Stickney, Tetra Tech, regarding subdivisions in Jefferson County. October 12.

Sturm, Gary. 2007. Personal Communication between Gary Sturm, Tetra Tech Engineer, and Alicia Stickney, Tetra Tech, regarding abandoned mine reclamation projects in Montana Tunnels area. October 16.

Tasse, N. 2000. Efficient Prevention of Sulphide Oxidation by an Organic Cover: For How Long can a Reactive Barrier be Reactive? In Proceedings from the 5th International Conference on Acid Rock Drainage, Volume II, p. 979-986.

Todd, D. K. 1991. *Ground-Water Hydrology*. John Wiley and Sons, Inc. New York, NY.

Tumlison, R. 1987. "Felis lynx". *Mammalian Species*. American Society of Mammalogists. 269: 1-8. Available online at: http://www.science.smith.edu/departments/Biology/VHAYSSEN/msi/msiaccounts.html

U.S. Bureau of Economic Analysis. 2004. "Table CA1-3, Personal Income." Regional Economic Accounts. May 25.

U.S. Bureau of Economic Analysis. 2004a. "Table CA3-4, Wage and Salary Disbursements-Montana." Regional Economic Accounts. December.

U.S. Census Bureau. 1997. Census of Population and Housing: Income and Poverty Status in 1989. March.

U.S. Census Bureau. 2000. "Tables DP 1-4, Selected Demographic and Economic Characteristics 2000, Jefferson County, Montana."

U.S. Environmental Protection Agency (EPA). 1979. Protective Noise Levels, Condensed Version of EPA Levels Document. EPA 550/9-79-100 (N-96-01 II-A-86).

EPA. 1994. Technical Document EPA 530-R-94-036 NTIS PB94-201829: Acid Mine Drainage Potential. 52p.

USDA Forest Service and others. 2002. Grizzly Bear Distribution Outside Recovery Zones: Map Development Process. Forest Service Northern Region, Missoula, MT. 2pp. (unpublished)

USDA Forest Service. 2005. Modeled potential lynx habitat, Lynx Analysis Unit DI-06, Helena National Forest. June 21.

USDA Forest Service. 2005. Electrofishing Survey Clancy Creek (6th Code HUC 100301011204). Helena National Forest data summary memorandum. September 9.

U.S. Department of the Interior (USDI). 1994. Montana Bald Eagle Recovery Plan. USDI, Bureau of Reclamation. 104pp.

USDI. 2003. Endangered and threatened wildlife and plants; notice of remanded determination of status for the contiguous United States distinct population segment of the Canada lynx; clarification of findings; final rule. U.S. Fish and Wildlife Service. Federal Register 50 Code of Federal Regulations, Part 17, Volume 68(128):6840076-6840101.

USDI. 2006. Endangered and threatened wildlife and plants; Designating the Northern Rocky Mountain population of gray wolf as a distinct population segment; removing the northern Rocky Mountain distinct population segment of gray wolf from the federal list of endangered and threatened wildlife. Federal Register 50 Code of Federal Regulations, Part 17, Volume 71(26): 6634-6660.

USDI BLM. 1996. Memorandum from BLM Director. Acid Rock Drainage Policy for Activities Authorized Under 43 CFR 3802/2809. Instruction Memorandum No. 96-79. April 2.

USDI BLM. 2001. BLM Manual 6840 – Sensitive Status Species Management.

USDI and others. 2006. Rocky Mountain Wolf Recovery 2005 Annual Report. U.S. Fish and Wildlife Service, Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Idaho Fish and Game, and USDA Wildlife Services. 2006. C.A. Sime and E. E. Bangs, eds. USFWS, Ecological Services, 585 Shepard Way, Helena, Montana. 59601. 130pp. Available at: http://westerngraywolf.fws.gov/annualrpt05/ Accessed March 27, 2006.

U.S. Department of Labor. 2004. "Local Area Unemployment Statistics," Bureau of Labor Statistics. Available online at: www.bls.gov.

U.S. Fish and Wildlife Service (USFWS). 1993. Grizzly Bear Recovery Plan. Missoula, MT.

USFWS. 2007. Federally listed and proposed endangered, threatened, experimental, and candidate species and habitat in Montana by county. Accessed online, March 16, 2007, at: http://montanafieldoffice.fws.gov/Endangered_Species/Listed_Species.html

van Zyll de Jong. 1985. *Handbook of Canadian mammals. Part 2, Bats.* National Museum of Natural Sciences, National Museums of Canada, Ottowa.

Werner, J.K., B.A. Maxell, P. Hendricks, and D.L. Flath. 2004. *Amphibians and Reptiles of Montana.* Mountain Press Publishing Company, Missoula, MT.

Wyllie, D.C., and Mah, C.W., 2004. *Rock Slope Engineering: Civil and Mining*. 4th Edition. Spon Press, London.

APPENDIX A: PRELIMINARY SECTION 404 (B)(1) SHOWING

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FIGURES

1.0 GENERAL INTRODUCTION

The Environmental Protection Agency's (EPA) 404(b)(1) Guidelines (40 CFR 230) are the substantive environmental criteria used in evaluating discharges of dredged or fill material into wetland and non-wetland waters of the United States (Waters of the U.S.) under Section 404 of the Clean Water Act, and are applicable to all 404 permit decisions. The Guidelines' purpose is to "restore and maintain the chemical, physical, and biological integrity of Waters of the U.S. through the control of discharges of dredged or fill material" (EPA 40 CFR 230.1[a]). The Guidelines therefore state that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (EPA 40 CFR 230.10[a]). Consequently, a primary function of the 404(b)(1) process is to evaluate and screen practicable alternatives relative to the discharge of dredged or fill material into Waters of the U.S. and determine compliance of the Proposed Action with the Guidelines. The term "practicable" as defined under the 404(b)(1) Guidelines means "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (EPA 40 CFR 230.3[q]).

This Preliminary Section 404(b)(1) Showing (Showing) represents the views of the Montana Department of Environmental Quality (DEQ) and the U.S. Bureau of Land Management (BLM) as to how the Proposed Action complies with the requirements of the 404(b)(1) Guidelines. It is not intended to represent the U.S. Army Corps of Engineers' (Corps of Engineers) views, conclusions or their final 404(b)(1) Evaluation. This Showing is intended to solicit public and agency input and comments, and foster increased public awareness and participation in the environmental impact statement (EIS) process.

1.1 REPORT ORGANIZATION

This Showing is generally organized according to the format of the EPA 404(b)(1) Guidelines and includes a discussion of: (1) screening of practicable alternatives, (2) discharge compliance with the Guidelines, (3) degradation of Waters of the U.S., (4) factual determinations of the potential short- and long-term effects of the proposed discharge on the aquatic environment, and (5) actions to minimize adverse effects. The format of the 404(b)(1) Guidelines is summarized below by Subpart.

Subpart A: General introduction including: purpose and policy (230.1); applicability (230.2); definitions (230.3); organization (230.4); procedures (230.5); adaptability (230.6); and general permits (230.7).

Subpart B: Compliance with the Guidelines including: restrictions on discharge (230.10); factual determinations (230.11); and findings of compliance or non-compliance with the restrictions on discharge (230.12).

Subpart C: Potential impacts on the physical and chemical characteristics of the aquatic ecosystem including: substrate (230.20); suspended particulate/turbidity (230.21); water (230.22); current patterns and water circulation (230.23); normal water fluctuations (230.24); and salinity gradients (230.25).

Subpart D: Potential impacts on biological characteristics of the aquatic ecosystem including: threatened and endangered species (230.30); fish, crustaceans, mollusks, and other aquatic organisms (230.31); and other wildlife (230.32).

Subpart E: Potential impacts on special aquatic sites including: sanctuaries and refuges (230.40); wetlands 9230.41); mud flats (230.42); vegetated shallows (240.43); coral reefs (230.44); and riffle and pool complexes (230.45).

Subpart F: Potential effects on human use characteristics including: municipal and private water supplies (230.50); recreational and commercial fisheries (230.51); water-related recreation (230.52); aesthetics (230.53); and parks, national and historic monuments, wilderness areas, research sites, or similar preserves (230.54).

Subpart G: Evaluation and testing including: general evaluations of dredged or fill material (230.60); and chemical, biological, and physical evaluation and testing (230.61).

Subpart H: Actions to minimize adverse effects including: location of the discharge (230.70); material to be discharged (230.71); control of material after discharge (230.72); method of dispersion (230.73); technology (230.74); actions affecting plant and animal populations (230.75); actions affecting human use (230.76); and other actions (230.77).

Subpart I: Planning to shorten permit processing time including the advanced identification of disposal areas (230.80).

Section 1.0 of this Showing addresses Subpart A of the Guidelines, while Section 2.0 addresses portions of Subpart B (230.10). Section 3.0 addresses portions of Subpart B (230.11) and Subparts C through G. Subpart H is addressed separately in Section 4.0. Section 5.0 presents preliminary conclusions of this assessment. Finally, one intent of the Showing is to accommodate Subpart I as referenced in a letter from the Corps of

Engineers to Montana Tunnels Mining Incorporated (Montana Tunnels) on November 30, 2004 stating that inclusion of a draft 404(b)(1) analysis in the draft EIS would provide Montana Tunnels with an opportunity to demonstrate compliance with sequencing requirements and should be included in any National Environmental Policy Act (NEPA) document to ensure timely permit issuance.

Similar to other section 404(b)(1) showings, this Showing includes a description of dredged or fill material and discharges in the aquatic ecosystem relative to the Montana Tunnels Proposed Action and the Agency-Modified Alternative (action alternatives). This description is provided in order to evaluate and analyze the discharge pursuant to Subparts B through H. For the purposes of this Showing, direct effects of the action alternatives are results of primary, mining- and construction-related impacts. Indirect effects of the Proposed Action may occur at some distance from the project site or can be associated with secondary impacts that occur after the project is operational. In addition, the Corps of Engineers Regulation 33 CFR 320.4a(2)i-iii requires consideration of the relative extent of public and private need, unresolved conflicts as to resource use, and the extent and permanence of the beneficial and/or detrimental effect that the Proposed Action is likely to have on the public and private uses to which the area is suited.

1.2 PROPOSED ACTION PROJECT DESCRIPTIONS

Montana Tunnels currently mines ore containing gold, zinc, lead, and silver from an open pit (the L-Pit) under existing Operating Permit 00113, issued by the State of Montana under the Montana Metal Mine Reclamation Act ([MMRA]; 82-4-301 et seq., Montana Code Annotated [MCA]), and under Plan of Operations No. MTM 82856 issued by BLM, referred to as the “Operating Permit”. The Montana Tunnels Mine is located in Jefferson County, Montana, approximately 25 miles south of the city of Helena (**Figure A-1**). Montana Tunnels wants to access and mine additional ore resources by expanding the existing L-Pit and has applied to DEQ and BLM for an amendment to its operating and reclamation plans (Montana Tunnels 2007a). Montana Tunnels requests permission to divert the course of two stream channels and place fill material in various Waters of the U.S. as specified in the proposed M-Pit operation and reclamation plans (Montana Tunnels 2007).

Two mine-related expansion areas are proposed – the northern expansion area (shown on **Figure A-2**) would enlarge the pit perimeter and excavate approximately 1,800 feet of Clancy Creek. Wetlands associated with the excavated channel would also be lost to the M-Pit Mine Expansion. The western expansion area would include a contingency waste rock storage area and the relocation of 3,800 feet of the Pen Yan Creek channel. The western expansion area was evaluated by the Corps of Engineers, which determined the area does not include any Waters of the U.S. The western area is not

considered further, and only the northern expansion area is evaluated in this Showing (**Figure A-2**).

Montana Tunnels evaluated five alternative Waters of the U.S. mitigation sites in 2005, as discussed in Section 2.1.4 and Section 4.1 of this Showing (Montana Tunnels 2007b). Based on the review of the alternative mitigation sites by the Corps of Engineers, and additional analysis by Montana Tunnels, Montana Tunnels proposes to use the Clancy Creek site as the preferred location to mitigate Clancy Creek wetland and stream impacts (**Figure A-3**).

1.2.1 Proposed Action Location

The Montana Tunnels Mine is located about 25 miles south-southwest of Helena in Jefferson County near the historic mining town of Wickes (**Figure A-1)**. The site is on the east flank of the Boulder Mountains at elevations of 5,300 to 6,300 feet. The expansion project area includes tributary watersheds to Prickly Pear Creek. The northwestern portion of the project area drains into Clancy Creek (**Figure A-2**); the remainder of the project area includes Homestake, Pen Yan, and Wood Chute creeks, tributaries to Spring Creek.

1.2.2 Alternative Designs for Proposed Actions

Montana Tunnels' preferred M-Pit mine plan as presented in the application to amend Operating Permit 00113 proposed a conventional open pit; the mine plan includes excavation and removal of a section of Clancy Creek adjacent to the existing L-Pit. No hillside layback adjacent to Clancy Creek is proposed as part of the preferred mine plan. Flow in the mined-out portion of Clancy Creek would be maintained using a combination of a pipe and constructed open-flow channel both during active mining and forever after mining ceases as part of the reclamation plan. Wetland and stream restoration would occur in a mitigation site downstream of the M-Pit Mine Expansion. The Montana Tunnels' proposed M-Pit Mine Expansion is referred to as "Alternative 2– Proposed Action Alternative (M-Pit)" in the Montana Tunnels Draft EIS (EIS), and is described in detail in Section 2.3 of the EIS.

The Corps of Engineers, BLM, and DEQ requested that Montana Tunnels evaluate a design alternative that would allow reestablishment of Clancy Creek in a constructed open-flow channel around the northwest edge of the pit. This design would require layback of the slope (36.9 acres) above the northwest M-Pit highwall. Wetland and stream channel impacts would be mitigated in the Clancy Creek valley downstream of the pit, and additional stream channel mitigation would occur by reestablishing a channel on a constructed bench between the pit rim and layback area. The additional alternative (Alternative 3) is referred to as "Alternative 3 – Agency Modified Alternative" in the EIS, and is described in detail in Section 2.4 of the EIS.

The two alternative designs are discussed in detail below.

1.2.3 EIS Alternative 2 Design

As part of Alternative 2, the M-Pit Mine Expansion would remove the Clancy Creek channel, underlying alluvium, and associated wetlands along approximately 1,800 feet of the Clancy Creek drainage (**Figure A-2**). Clancy Creek surface water and groundwater upstream of the pit would be diverted around the mine perimeter using a combination of a pipe and an open-flow channel. A cutoff wall would be constructed to divert groundwater. The diverted flow would rejoin Clancy Creek downstream of the pit a total distance of 2,600 feet from the upstream diversion. The combined pipe and open-flow channel diversion system is designed to divert and convey a maximum design flow of 15 cubic feet per second (cfs) corresponding to the estimated peak discharge for the 1 in 5 five year flow event. The 2,000-foot-long, 16-inch-diameter high-density polyethylene pipe would be buried to provide protection from freezing, ultraviolet degradation, and rockfall damage. The diversion pipe would discharge flow into a 600-foot open-flow channel at an ephemeral-flow drainage. **Figure A-4** provides a general layout of the Montana Tunnels' proposed preliminary design for the Clancy Creek diversion (Montana Tunnels 2007a).

An intake structure would be located on Clancy Creek about 500 feet from the edge of the mine pit. The intake structure would consist of an earth and rock embankment dam, a slurry or sheet pile cut-off wall, a concrete spillway, and an intake facility. This structure would capture surface and subsurface flow and direct water into a diversion pipe. Excess flow would pass over the spillway and be routed through an overflow ditch into the mine pit. **Figure A-5** provides a general layout of the Montana Tunnels' proposed preliminary design for the Clancy Creek intake structure (Montana Tunnels 2007a).

Seasonal surface water and groundwater from an ephemeral-flow tributary to Clancy Creek would also be captured by an intake structure. Combined flows from Clancy Creek and the ephemeral-flow drainage would enter an open-flow channel and reenter the Clancy Creek valley about 600 feet downstream from the tributary drainage. The open-flow channel would be designed to accommodate at least 15 cfs from Clancy Creek plus the 7 cfs from the tributary drainage. The open-flow channel would be 18 feet wide and 4 feet deep and would be lined to prevent water seepage to ground in the area of the mine pit. **Figure A-6** provides a general layout of the Montana Tunnels' proposed preliminary design for the ephemeral drainage and open-flow channel (Montana Tunnels 2007a).

At the conclusion of mining, a portion of Clancy Creek would be diverted into the mine pit to form a lake that would eventually reach equilibrium at elevation 5,625 feet about two centuries after mining ceases (Montana Tunnels 2007a). This estimate is based on

computer modeling conducted by Montana Tunnels and evaluated by the agencies, as discussed in Section 3.6 of the EIS. The amount of flow to be diverted was not quantified in the application.

Wetland and stream mitigation would be conducted in the Clancy Creek valley downstream of where the flows from the proposed open-flow channel would reenter the valley (**Figure A-3**).

1.2.4 EIS Alternative 3 Design

Under Alternative 3, the hillside would be laid back to accommodate a constructed open-flow channel soon after commencing the M-Pit Mine Expansion, as discussed further below. This channel would mimic the present Clancy Creek channel and would be capable of conveying the 1 in 20 year return period 24 hour storm event. **Figure A-7** provides a general layout for the preliminary design of the relocated channel for Clancy Creek for EIS Alternative 3 (Montana Tunnels 2007a). Any flows greater than the 1 in 20 year return period 24 hour storm event would be routed into the M-Pit.

In order to provide sufficient room for the channel, the natural slope above the temporary diversion system would be laid back at a 2H:1V slope angle. This would accommodate a constructed drainage channel at a distance ranging from 200 to 250 feet from the crest of the mine pit and 50 feet from the toe of the proposed layback. The large volume of earth from the slope layback (approximately 4.8 million cubic yards) would be hauled to the waste rock storage area.

The minimum buffer width of 200 feet from the pit rim would provide security for the relocated stream channel. Stability analyses indicate that the lowest factor of safety of 1.4 is related to a 'critical failure' surface situated approximately 100 feet from the pit rim (Montana Tunnels 2007a). The design places the stream channel a minimum of 50 feet from the toe of the layback slope to accommodate rockfall and potential sedimentation, although the 2H:1V layback slope is expected to be stable following revegetation. To reduce erosion from the layback slope and improve the aesthetics of the layback slope, diversion ditches would be installed at the top of the slope layback and the layback slope would be designed with a dendritic drainage pattern and a concave slope. **Figures A-8, A-9, and A-10** provides cross-sections of the preliminary design for the Clancy Creek channel (Montana Tunnels 2007b).

The permanent relocated open-flow channel would be constructed during the initial phases of the M-Pit Mine Expansion, following the partial layback and reclamation of the 36.9-acre hillside above the Clancy Creek diversion area. The diversion channel would be constructed before the natural Clancy Creek channel is removed. When flow is diverted into the newly constructed channel, the realigned channel would be the final

constructed channel during the remainder of active mining as well as at the conclusion of all mining activities.

In contrast to EIS Alternative 2, for EIS Alternative 3 no water from Clancy Creek would be diverted into the mine pit at the conclusion of mining. The realigned constructed open-flow channel would permanently convey surface water and groundwater of upstream Clancy Creek and the ephemeral drainage around the mine pit. The design flow for surface water would be the 1 in 20 year return period 24 hour storm event.

As with EIS Alternative 2, wetland and stream channel impacts would be mitigated in the Clancy Creek valley downstream of where flows from the reconstructed channel reenter the valley. The reconstructed channel around the M-Pit would provide additional channel mitigation for the mined-out channel. Additionally, the reconstructed channel around the pit would allow for creation of a wetland fringe along the channel. **Figure A-11** provides a cross section of the preliminary design for the Clancy Creek Mitigation site. Figure A-12 illustrates the proposed fish habitat enhancement for the Alternative 3 design.

2.0 COMPLIANCE WITH THE GUIDELINES

2.1 SECTION 230.10 – RESTRICTIONS ON THE DISCHARGE

2.1.1 Section 230.10(a): Practicable Alternative Screening

EIS Alternative 1 - No Action Alternative (L-Pit), and two action alternatives are described in Chapter 2 and analyzed in Chapter 3 of the EIS. EIS Alternative 2 - Proposed Action Alternative (M-Pit) is the Montana Tunnels Proposed Action. EIS Alternative 3 -Agency Modified Alternative was developed in response to six important issue areas identified during the scoping process and agencies' discussions. Issue areas are summarized in Section 1.7 of the EIS, and include hydrology, wetlands and Waters of the U.S., fisheries and aquatics, wildlife, engineering, and socioeconomics.

The effects on wetlands and Waters of the U.S. were identified as one of the potential issues to drive the development of the EIS alternatives and evaluation of impacts. The affected acreage of wetlands and Waters of the U.S. for the two EIS action alternatives (EIS Alternatives 2 and 3,) is provided in **Table A-1**.

EIS Alternative 1 - No Action Alternative (L-Pit), is Montana Tunnels L-Pit Plan as it is presently permitted to operate by DEQ and BLM. Under EIS Alternative 1, the M-Pit Mine Expansion would not occur. No impact to wetlands or Waters of the U.S. would occur.

Both EIS action alternatives (EIS Alternative 2 and Alternative 3) would result in the excavation and removal of approximately 1,800 feet of the Clancy Creek drainage,

disturb an additional 600-foot long reach of the existing Clancy Creek channel, and fill wetlands and Waters of the U.S.

In addition to the three EIS alternatives, a number of alternatives suggested during scoping were determined by the agencies to be infeasible or otherwise unreasonable. The dismissed alternatives and their reasons for dismissal are discussed in detail in Section 2.6 of the EIS. The dismissed alternatives include:

Accelerate Formation of a Post-Mining Pit Lake

The option to accelerate formation of a post-mining pit lake by pumping water from Prickly Pear Creek and Spring Creek was considered in order to increase pit highwall stability and create a reducing environment for insulating the sulfide-containing mineralized diatreme in the lower highwalls of the mine pit. This option was dismissed because the same effect would be achieved by natural raveling and sloughing of rock with lower sulfide content from the upper pit highwall as the pit stabilizes after mining is completed. (EIS Alternative 3).

Castblasting to Reduce Pit Highwalls

Castblasting of pit highwalls to reduce upper pit highwall slopes was considered to accelerate pit filling and cover acid generating rock at the bottom of the pit as soon as possible and increase long-term pit stability. Castblasting was dismissed because natural rockfall over time after mining would be sufficient to cover the bottom of the pit.

Step 1. Definition of Purpose and Need

Montana Tunnels was permitted to mine an average of 15,000 tons per day (Montana Department of State Lands [DSL] 1985 and DSL 1986). The mining method has not changed since the mine was approved in 1986. The mine currently produces 11,000 to 20,000 tons of ore per day. Projected average annual ore production is 4 to 6 million tons depending on conditions through the remaining approved L-Pit Plan (EIS Alternative 1). The cutoff grade is determined by the market price of all metals; the price of gold is an influential component of the analysis. Ore control, cutoff grade, and reserves historically have been based on a gold equivalent formula that took into account recoveries, smelter charges, mineral grades, and metal prices. Dramatic changes in any of these areas could lessen or enlarge reserves. For example, the average cutoff grade based on all economic considerations in 2004 was 0.016 ounce per ton gold equivalent (Montana Tunnels 2007); however, Montana Tunnels currently no longer establishes cutoff grade based on gold equivalent (Montana Tunnels 2007).

Montana Tunnels is currently permitted to mine a total of 102 million tons of ore. Montana Tunnels wants to access and mine additional ore resources estimated to range from 24 to 28 million additional tons and extend the life of mine an additional five years from 2009 through 2013 (Montana Tunnels 2007a).

Step 2. Identify Alternatives

EIS Alternative 1 - No Action Alternative (L-Pit) was retained as an alternative to be considered in this Showing. In addition, two action alternatives considered in the EIS as described in Section 1.2.3 of this Showing (EIS Alternative 2) and Section 1.2.4 of this Showing (EIS Alternative 3) were retained as the alternatives to analyze within this Showing and are the basis for the following screening process.

Step 3. Level 1 Screening

EIS Alternative 1 - No Action Alternative (L-Pit) does not meet the stated purpose and need of providing additional ore resources estimated to range from 24 to 28 million additional tons and does not extend the life of mine an additional five years. Each of the EIS action alternatives (EIS Alternative 2 and Alternative 3) meets the stated objectives of accessing and mining 24 to 28 million additional tons of ore and extends the life of mine an five additional years. EIS Alternative 1 was eliminated based on Level 1 screening.

Step 4. Level 2 Screening

Each of the EIS action alternatives (EIS Alternative 2 and Alternative 3) was evaluated relative to impacts to wetlands and Waters of the U.S. from mining- and construction-specific, probable, adverse environmental impacts. This evaluation is summarized below.

Both EIS action alternatives (EIS Alternative 2 and Alternative 3) would excavate and remove approximately 1,800 feet of the Clancy Creek drainage, disturb an additional 600-foot-long reach of the existing Clancy Creek channel, and fill wetlands and Waters of the U.S. For EIS Alternative 2, Clancy Creek surface water and groundwater upstream of the pit would be diverted around the M-Pit using a combination of a 2,000-foot-long pipe and a 600-foot open-flow channel, both during the mine expansion and at the conclusion of mining (Montana Tunnels 2007a). For EIS Alternative 3, Clancy Creek surface water and groundwater upstream of the M-Pit would be diverted around the mine pit in a constructed open-flow stream channel soon after commencing the M-Pit Mine Expansion.

For EIS Alternative 2, a portion of Clancy Creek would be diverted into the M-Pit at the conclusion of mining to form a lake that would reach equilibrium at elevation 5,625 feet (about 25 feet below the elevation of Clancy Creek) about two centuries after mining

ceases (Montana Tunnels 2007a). For EIS Alternative 3, no water from Clancy Creek would be diverted into the mine pit at the conclusion of mining. Instead, the realigned constructed open-flow channel would permanently convey surface water and groundwater (of upstream Clancy Creek and the ephemeral drainage) around the mine pit. Additional water (estimated annualized flow equal to 100 gallons per minute (gpm) [0.22 cfs]) would be available in Clancy Creek downstream of the mine pit for EIS Alternative 3, relative to EIS Alternative 2.

Both EIS action alternatives (Alternative 2 and Alternative 3) would impact wetlands. **Table A-1** provides the wetland types and acres that would be directly and indirectly impacted by the M-Pit Mine Expansion into the Clancy Creek drainage for both EIS Alternative 2 and Alternative 3. Clancy Creek wetland areas are shown on **Figure A-2**. The primary difference between EIS Alternatives 2 and 3 for wetlands is that EIS Alternative 3 provides potential for some additional wetlands to naturally reestablish along the full length of the reconstructed Clancy Creek channel; no wetlands would establish along the portion of Clancy Creek contained in a pipe under Alternative 2.

In addition, there would be relatively less loss of aquatic habitat for EIS Alternative 3 compared to Alternative 2 because Clancy Creek would be rerouted to a constructed open-flow channel that mimics the existing channel rather than into a 2,000-foot-long, 16-inch-diameter high-density polyethylene pipe, and habitat would remain connected thus providing an environment that could potentially support existing biota.

Lastly, unavoidable adverse effects on other, non-Waters of the U.S. resources were evaluated in the EIS, and are summarized in **Table A-2**.

Summary

The results of the practicable alternative screening process demonstrate that:

- The EIS Alternative 1 - No Action Alternative (L-Pit) does not meet the stated purpose and need of providing additional ore resources estimated to range from 24 to 28 million additional tons and does not extend the life of mine an additional five years.
- The EIS action alternatives (EIS Alternative 2 and Alternative 3) do meet the stated purpose and need of providing additional ore reserves and extend the life of mine an additional five years.
- Both EIS action alternatives (EIS Alternative 2 and Alternative 3) would result in the excavation and removal of approximately 1,800 feet of the existing Clancy Creek channel and associated wetlands (**Figure A-2**).
- EIS Alternative 2 would, result in the diversion of Clancy Creek surface water and groundwater upstream of the pit around the mine perimeter using a

combination of 2,000-foot-long pipe and a 600-foot open-flow channel (**Figure A-4**).

- EIS Alternative 3 would result in the rerouting of Clancy Creek to a constructed open-flow channel that mimics the present Clancy Creek channel and would convey up to the 1 in 20 year return period 24 hour storm event.
- EIS Alternative 2 would result in the diversion of a portion of Clancy Creek into the M-Pit at the conclusion of mining. Under EIS Alternative 3, none of the flow of Clancy Creek (except storm events greater than the channel design flow equal to the 1 in 20 year return period 24 hour storm event) would be diverted into the mine pit; instead a realigned constructed open-flow channel would permanently convey surface water around the mine pit. More water (estimated annualized flow equal to 100 gpm [0.22 cfs]) would be available in Clancy Creek downstream of the mine pit for EIS Alternative 3.
- Both EIS action alternatives (EIS Alternative 2 and Alternative 3) would result in an equal impact to wetlands (**Table A-1**).
- EIS Alternative 3 would provide potential for some additional wetlands and aquatic habitat to naturally reestablish along the full length of the reconstructed Clancy Creek channel (**Figure A-7**). No wetlands would establish along the portion of Clancy Creek contained in a pipe for EIS Alternative 2.
- EIS Alternative 2 would result in the loss of connection of stream habitat upstream of the mine pit diversion proposed for Clancy Creek, and the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek. The 2,000-foot-long pipe would not be an adequate environment to support existing biota.
- Impacts to biota for EIS Alternative 3 would be less than EIS Alternative 2 because Clancy Creek would be rerouted to a constructed open-flow channel that mimics the existing channel rather than into a 2,000-foot long, 16-inch diameter high-density polyethylene pipe, and habitat would remain connected, thus providing an environment that could potentially support existing biota.

In conclusion, considering impacts to the aquatic ecosystem and other adverse environmental consequences that could result from implementation of each EIS Alternative (**Table A-2**), EIS Alternative 3 is the best practicable alternative with the least amount of mining- and construction-related impacts that could not be mitigated.

2.1.2 Section 230.10(b) - Discharge Compliance with Guidelines

The 404(b)(1) guidelines Section 230.10(b) require that no discharge shall be authorized if it:

- Causes or contributes to any violation of applicable water quality standards.

- Violates any applicable toxic effluent standard or prohibition under Section 307 of the Act.
- Jeopardizes the continued existence of species listed as threatened or endangered under the Endangered Species Act (ESA) of 1973, as amended, or results in likelihood of the destruction or adverse modification of critical habitat under the ESA of 1973.

Activities related to mine expansion, excavation of Clancy Creek, wetlands mitigation, and associated mining- and construction-related activities in the Clancy Creek drainage have been evaluated under the following:

State water quality standards: DEQ provides Section 401 certification pursuant to the state rules (ARM 16.20.1701 et seq.). DEQ has reviewed the data presented in the EIS related to the disturbance (or discharge) of material and will make a determination for violations of applicable state water quality standards. DEQ will not make its final ruling until the Corps of Engineers completes its final 404(b)(1) evaluation. Section 404 permits, issued by the Corps of Engineers, require Section 401 certification. Any conditions to the 401 certification would be conditions of the Section 404 permit. A Section 401 certification does not constitute a relinquishment of DEQ authority, or any subsequent alterations or additions thereto, nor does if fulfill or waive any other local, state, or federal regulations.

Toxic effluent standard or prohibition: Documentation of analysis of material to be disturbed/discharged as a result of the project is contained in the EIS. Determination of compliance with Section 307 of the Clean Water Act is encompassed in DEQ review. Section 307 requires review of the project in light of the possible introduction of toxic pollutants. As indicated above, water quality certification pursuant to Section 401 of the Clean Water Act would be required. All conditions identified in the Section 401 certification would be included as conditions, should the 404(b)(1) evaluation result in a recommendation to issue a permit.

Threatened or endangered species: Impacts to threatened or endangered species were addressed in Section 3.9.3 of the EIS and are addressed in Section 3.5.3 of this Showing. To comply with the ESA, a biological assessment was prepared by BLM that evaluates the potential effects on threatened and endangered species that may be present in the project area. The BLM and USFWS would review the document and the USFWS would render a biological opinion. If the BLM determines that the preferred alternative may jeopardize the continued existence of a species, it may offer a reasonable and prudent alternative that would, if implemented, preclude jeopardy. Montana Tunnels must successfully meet the requirements of this section of the 404(b)(1) guidelines in order for the 404(b)(1) evaluation to result in a recommendation to issue a permit. The applicant realizes failure to meet the requirements of this section would result in a recommendation of denial.

2.1.3 Section 230.10(c) - Degradation of Waters of the U.S.

Project impacts that would cause or contribute to degradation of Waters of the U.S. are addressed throughout this Showing and in the EIS. The recommendation to issue a permit would be based on the assessment of the project impacts and the proposed mitigations. In order to conclude that the Montana Tunnels Mine project would not cause or contribute to degradation of Waters of the U.S, Montana Tunnels must successfully meet the requirements of this section of the 404(b)(1) guidelines.

Section 230.10(c) of the guidelines prohibits the discharge of dredge or fill material that would cause or contribute to degradation of Water of the U.S. Findings of degradation must be based on factual determinations, evaluations, and testing. 33 CFR Part 320.4(b)1-3 also states that the unnecessary alteration or destruction of wetlands should be discouraged as contrary to the public interest.

Degradation of the Waters of the U.S. as it applies to wetlands and Clancy Creek surface water resources is discussed in detail below.

Wetlands

From a national perspective, the degradation or destruction of wetlands, and other special aquatic sites, is considered to be the most severe environmental impact covered by the 404(b)(1) guidelines. Wetlands perform various functions that are vital to the integrity of the wetland system and contribute to the overall quality of the nation's waters. Examples of these wetland functions are groundwater recharge and discharge, sediment stabilization, sediment/toxicant retention, and nutrient removal/ transformation. Other wetland functions considered to be important to the public interest and which serve biological functions are the providing of: general habitat (nesting, spawning, rearing, and resting sites); aquatic diversity and abundance; wildlife diversity and abundance; recreation; and uniqueness in nature or scarcity in the region.

Montana Tunnels completed the identification and delineation of wetlands and Waters of the U.S. for the mine project area with technical assistance from WESTECH Environmental Services, Inc. (WESTECH 2006) in August 2003 and July 2004. The wetland inventory utilized site-specific information for vegetation, soils, and hydrology collected during baseline evaluations of the Montana Tunnels Mine expansion areas. On-site field work followed the Wetland Delineation Manual developed in 1987 (Environmental Laboratory 1987).

Only areas proposed for disturbance by the Montana Tunnels' mining project were delineated, and the Corps of Engineers conducted a field verification of these proposed expansion areas on June 21, 2005 (**Attachment A-1**). The Corps of Engineers determined that an area mapped as potentially jurisdictional just downstream from plot MT03-6 on

Clancy Creek did not have hydrologic indicators and was non-wetland (**Attachment A-1**; **Figure A-2**). The Corps of Engineers also determined that potentially jurisdictional wetlands mapped along Pen Yan Creek were not jurisdictional, since stream flows in this reach of Pen Yan Creek do not reach navigable waters. Therefore, Pen Yan Creek is not further evaluated in this Showing. Wetlands determined to be jurisdictional by the Corps of Engineers and DEQ are regulated pursuant to Sections 404 and 401 of the federal Clean Water Act.

Table A-1 provides a summary of wetland types and acreages impacted by EIS Alternatives 2 and 3. **Table A-3** provides a list of common species occurring in Wetlands along Clancy Creek within the mine expansion area. Clancy Creek wetlands that would be lost are primarily palustrine scrub-shrub (PSS) and palustrine forest (PFO) with small areas of palustrine emergent (PEM) wetlands based on the classification of Cowardin and others (1979**)**. The 1- to 4-foot-wide Clancy Creek channel is incised 1 to 2 feet deep except for a short section where it is has a 4- to 6-foot incised channel. Water is 1 to 6 inches deep (in August) over a generally gravel-lined channel. In the segment of Clancy Creek proposed to be removed by the expanded M-Pit Mine Expansion, the channel is classified as riverine, upper perennial with a gravelly unconsolidated bottom (R3UB1). Below the mine expansion area, Clancy Creek loses flow and becomes intermittent in dry years.

Drummond willow (*Salix drummondiana*) and Booth willow (*Salix boothii*) dominate the overstory of the scrub-shrub wetland type. Understory species vary with moisture regime: wettest sites contain beaked sedge (*Carex rostrata*), bluejoint reedgrass (*Calamagrostis canadensis*), and redtop (*Agrostis stolonifera*), while less wet sites contain more Kentucky bluegrass (*Poa pratensis*) and common timothy (*Phleum pratense*).

Two palustrine forested types occur along Clancy Creek. The quaking aspen (*Populus tremuloides)* type is present adjacent to the existing L-Pit and is dominated by quaking aspen and thinleaf alder (*Alnus incana).* Redtop and Kentucky bluegrass are common understory species. Upstream of the mine pit, the valley narrows and conifers are the prevalent overstory species. Engelmann spruce (*Picea engelmannii)* and Douglas fir (*Pseudotsuga menziesii*) dominate a mixed understory of shrubs, grasses, and forbs. Prominent understory species include red raspberry (*Rubus idaeus*), thinleaf alder, Bebb's willow (*Salix bebbiana)*, redtop, bluejoint reedgrass, and common horsetail (*Equisetum arvense*).

The palustrine emergent type has marginal wetland characteristics and is dominated by herbaceous species including Kentucky bluegrass, common timothy, Baltic rush (*Juncus balticus*), common yarrow (*Achillea millefolium*), and Nebraska sedge (*Carex nebraskensis*).

Wetland functions and values for Clancy Creek were evaluated using the Montana Wetland Assessment Method (Berglund 1999). **Attachment A-2** provides the results of

the wetland functions and values assessment. Clancy Creek wetlands rated high for general fish/aquatic habitat, flood attenuation, production export/food chain support, and groundwater discharge/recharge. Using a four category ranking system (I through IV, with I being highest), Clancy Creek wetlands ranked a Category II.

Surface Water Resources

As discussed in Section 2.1 of this Showing, both EIS action alternatives (Alternative 2 and Alternative 3) would result in the excavation and removal of approximately 1,800 feet of the Clancy Creek drainage. For EIS Alternative 2, surface water and groundwater in Clancy Creek would be diverted into the mine pit at the conclusion of mining and would no longer be available downstream of the M-Pit.

Clancy Creek is a small perennial stream flowing adjacent to the northwest side of the L-Pit (**Figure A-2)**. Elevations within the Clancy Creek drainage basin range from approximately 7,800 feet in its headwaters to 5,550 feet at the permit boundary. The stream originates from springs and historic mine adit flows approximately 1 mile upstream of the Montana Tunnels Mine pit in a steep, conifer-forested canyon with a drainage area of approximately 1,000 acres. The stream channel is flanked by wooded and herbaceous riparian areas with moderate sinuosity and a moderate to steep gradient.

Flow in Clancy Creek has been measured at two surface water monitoring stations (SW-16 and SW-16B), as shown on **Figure 3.7-1** of the EIS. Surface water monitoring station SW-16 is located just downstream of the mine pit; monitoring station SW-16B is located 1 mile downstream of the pit and about one-half mile downstream of the confluence of Kady Gulch with Clancy Creek (**Figure 3.7-1** of the EIS**).**

Flow at station SW-16 was measured several times during the period 1992 through 1994, once in 1995, and once again in 2003. Measured flows ranged from 0 gpm (0 cfs) to 1,333 gpm (2.97 cfs). The average flow for all measurements was 655 gpm (1.46 cfs). Montana Tunnels estimates that the long-term annualized average flow in Clancy Creek in the vicinity of the mine pit is about 100 gpm (0.22 cfs). The 1 in 5 year return period flow for Clancy Creek near station SW-16 was estimated to be 6,732 gpm (15 cfs) (Montana Tunnels 2007a).

In general, Clancy Creek exhibits good water quality in the area of the mine pit, even though there is some effect from historic mine drainage introduced into the creek at an upstream tributary location. Clancy Creek is soft to moderately hard with corresponding low levels of dissolved solids, total alkalinity, and metals and near-neutral pH. On average, the metals concentrations appear to be higher when the flow volume is lower. The concentrations of metals at surface water monitoring station SW-16 have met DEQ-7 surface water standards for human health, except for cadmium. The

concentrations of cadmium, copper, and lead have sometimes exceeded the DEQ-7 acute or chronic aquatic water quality standards. Detailed information related to surface water flow and water quality in Clancy Creek is provided in Section 3.7 of the EIS.

2.1.4 Section 230.10(d) - Appropriate and Practicable Steps to Minimize Potential Adverse Impacts of the Discharges on the Aquatic Ecosystem

Actions that would be taken to avoid or minimize adverse effects, as considered in Subpart H of the Guidelines are discussed in Section 4.0 of this Showing.

3.0 FACTUAL DETERMINATIONS AND POTENTIAL IMPACTS

3.1 PHYSICAL SUBSTRATE IMPACTS AND DETERMINATIONS

The substrate of the aquatic ecosystem is considered in Section 230.11(a) and 230.20 of the Guidelines. Both EIS action alternatives (EIS Alternative 2 and Alternative 3) would result in the excavation and removal of approximately 1,800 feet of the Clancy Creek drainage and associated wetlands, disturb an additional 600-foot long reach of the existing Clancy Creek channel, and affect existing wetlands and Waters of the U.S. in the wetlands mitigation area on Clancy Creek (**Figure A-3**). A total of 2.64 acres of wetland would be impacted of which 2.11 acres would be directly impacted and 0.53 acre indirectly impacted. Additionally, 2.13 acres of scrub/shrub and emergent wetlands would be directly impacted within the Clancy Creek mitigation site as a result of construction to install a low permeability liner to ensure wetland hydrology within the mitigation site (Montana Tunnels 2007b).

3.1.1 Substrate Elevation and Slope

For EIS Alternative 2, the Clancy Creek channel would be excavated and flow in the mined-out portion of Clancy Creek would be rerouted using a combination of a 2,000-foot-long pipe and 600-foot-long constructed open-flow channel, both during active mining, and forever after mining ceases as part of the reclamation plan. **Figure A-2** and **Figure A-4** show the areal extent of the M-Pit Mine Expansion and the proposed substrate elevations and slopes. Wetland and stream restoration would occur in a mitigation site downstream of the pit expansion. No permanent changes in substrate elevation or slope would occur downstream of the constructed open-flow channel.

For EIS Alternative 3, a constructed open-flow channel would be built around the mine pit soon after commencing the M-Pit Mine Expansion. EIS Alternative 3 substrate elevations and slopes are shown in **Figure A-7**. No permanent changes in substrate elevation or slope would occur downstream of the constructed open-flow channel.

3.1.2 Comparison of Fill Materials and Substrate at Discharge Site

Fill materials and substrate at the discharge site are discussed in Section 4.2 of this Showing. Impacted wetlands would be mitigated prior to mine expansion, if possible. Soils from the mitigation site, including hydric soils from existing wetlands and deep loams suitable for supporting hydrophytic vegetation, would be salvaged from and redistributed on the mitigation site. With establishment of wetland hydrology, these soils would develop hydric characteristics.

Hydric soils from the M-Pit Mine Expansion area would be salvaged and redistributed adjacent to the reestablished channel if EIS Alternative 3 is implemented. If the permitting and mine expansion schedules do not allow for mitigation prior to wetland impact, hydric soils from the impact area would be used on the mitigation site (Montana Tunnels 2007a).

3.1.3 Dredged/Fill Material Movement

As part of EIS Alternative 2 and Alternative 3, the M-Pit Mine Expansion would remove the Clancy Creek channel, underlying alluvium, and associated wetlands along approximately 1,800 feet of the Clancy Creek drainage (**Figure A-4** and **Figure A-7**). A total of 2.64 acres of wetland would be impacted of which 2.11 acres would be directly impacted and 0.53 acres indirectly impacted (**Table A-1**). Additionally, 2.13 acres of scrub/shrub and emergent wetlands would be directly impacted within the Clancy Creek mitigation site.

EIS Alternative 3 also incorporates a 36.9 acre hillside layback to provide structural integrity for the constructed Clancy Creek channel. To ensure long-term channel stability, it would be necessary to relocate the Clancy Creek channel within a 300-foot-wide bench, and positioned 200 to 250 feet from the crest of the northwest highwall. The volume of waste rock from the pit slope layback is estimated to be about 4.8 million cubic yards. The waste rock would be hauled to the waste rock storage area.

A temporary increase in soil and substrate movement along Clancy Creek would occur during pit excavation and construction of the wetlands mitigation site. Installing appropriate best management practices (BMPs), such as silt fencing between the mitigation area and the downstream undisturbed area, would reduce material movement.

3.1.4 Physical Effects on the Benthos

Benthos are animals and plants that live on lake bottoms or streambeds. Impacts related to EIS Alternative 2 related to benthos are discussed in detail in Section 3.10.3.2 of the EIS. Impacts related to EIS Alternative 3 related to benthos are discussed in Section 3.10.3.3 of the EIS. For EIS Alternative 2, there would be (1) the loss of 1,800 feet

of aquatic habitat in Clancy Creek that would be excavated and replaced with a 16-inch-diameter pipe, (2) the loss of connection of stream habitat in Clancy Creek upstream of the mine pit diversion, and (3) the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek. The pipe would not be an adequate environment to support existing benthos. Impacts for EIS Alternative 3 would be less than EIS Alternative 2 during mine operations because Clancy Creek would be rerouted to a constructed open-flow channel that mimics the existing channel soon after commencing the M-Pit Mine Expansion rather than into a 2,000-foot-long, 16-inch-diameter high-density polyethylene pipe, and habitat would remain connected, thus providing an environment that could potentially support benthos.

3.1.5 Erosion and Accretion Patterns

Erosion and accretion patterns would experience short-term effects from both EIS action alternatives. M-Pit Mine Expansion, channel excavation, and related wetlands mitigation and mining- and construction-related activities would increase stream bank erosion rates and alter stream accretion patterns. These effects would be more pronounced at the time of excavation and construction and would persist as minor effects until vegetation is reestablished along the disturbed stream banks. With application of BMPs and proper reclamation, erosion and accretion would be reduced and no long-term effects are anticipated.

3.1.6 Actions Taken to Minimize Impacts to the Substrate

Actions that would be taken to minimize adverse effects, as in Subpart H of the Guidelines, are discussed in Section 4.0 of this Showing.

3.2 WATER, CURRENT PATTERNS, WATER LEVEL FLUCTUATION, AND SALINITY DETERMINATION

The water within an aquatic ecosystem contains dissolved and suspended organic and inorganic constituents. This composition of the water, together with water circulation and currents, fluctuations in water level, and salinity gradients (if present) help to characterize an aquatic system.

3.2.1 Water Chemistry

The composition of the dissolved and suspended constituents in water, considered in Sections 230.11(b), 230.22 and 230.25 of the Guidelines, are important factors in a system's ability to support aquatic life and human uses. Clancy Creek is classified by DEQ as a B-1 stream, meaning that beneficial uses for "drinking, culinary and food processing (after conventional treatment), bathing, swimming and recreation, growth and propagation of salmonids and aquatic life, waterfowl and furbearers, agriculture and industrial purposes" must be maintained. Existing water quality in Clancy Creek is

such that some of the beneficial uses are impaired. As a result, Clancy Creek is listed on the DEQ 303(d) list for impaired waters. The specific uses that Clancy Creek does not support are aquatic life, growth and propagation of salmonids, and drinking water. The probable causes of impairment are contamination by various metals, channel and habitat alterations, and siltation. The probable sources of these causes are agriculture, resource extraction (mining) and roads.

It is anticipated that EIS Alternatives 2 and 3 would affect water clarity, color, suspended particulates, and turbidity downstream of the mine pit expansion and associated excavation of the Clancy Creek channel, and downstream of any construction and wetlands mitigation activities, at the time these activities occur. These impacts would be most pronounced during earth moving and may continue as minor impacts for the short term following the disruption until channel banks have stabilized and been revegetated. For EIS Alternative 3, Montana Tunnels would collect operational geochemical data and conduct testing on material from the hillside layback required to construct the Clancy Creek channel (**Figure A-2**) to assess the likelihood of potential long-term Clancy Creek water quality issues associated with acid-producing potential of rock within the layback, if present.

3.2.2 Current Patterns and Circulation

Current patterns and water circulation, considered in Section 230.11(b) and 230.23 of the Guidelines, are the physical movements of water in the aquatic ecosystem. Impacts relating to the current and water circulation would occur for EIS Alternative 2 and Alternative 3.

For EIS Alternative 2, Clancy Creek surface water (up to the 1 in 5 year flood event) and groundwater upstream of the pit would be diverted around the M-Pit using a combination of pipe and an open-flow channel during active mining operations (**Figure A-4**). Flow in Clancy Creek greater than the design event would be diverted into the mine pit and managed as makeup water for the mill. A cutoff wall would be constructed to divert groundwater. The diverted flow would rejoin Clancy Creek downstream of the pit a total distance of 2,600 feet from the upstream diversion. At the conclusion of mining, a portion of Clancy Creek would be diverted into the mine pit to form a lake that would reach equilibrium at elevation 5,625 feet about two centuries after mining ceases.

Under EIS Alternative 3 none of the flow of Clancy Creek (except storm events greater than the channel design flow equal to the 1 in 20 year return period 24 hour storm event) would be diverted to the pit at the conclusion of mining. Instead, Clancy Creek would be rerouted to a constructed open-flow channel soon after commencing the M-Pit Mine Expansion. The constructed channel would permanently convey surface water and groundwater of upstream Clancy Creek and the ephemeral drainage around the

mine pit. More water (estimated annualized flow equal to 100 gpm [0.22 cfs]) would be available in Clancy Creek downstream of the mine pit for EIS Alternative 3.

For both EIS Alternative 2 and Alternative 3, a wetlands mitigation site would be constructed (**Figure A-3**). The Clancy Creek mitigation site contains 6.54 acres of upland and 2.13 acres of wetland for a total size of 8.67 acres. A meandering stream channel would be constructed within the mitigation site to achieve a comparable length of all impacted channels. Two channels currently exist in the upper portion of the mitigation site, of which only one usually contains flow. For EIS Alternative 3, the Clancy Creek channel would be reconstructed on the bench above the M-Pit and would add to the total length of mitigated stream channel (**Figure A-7**).

3.2.3 Normal Water Level Fluctuations

Normal water level fluctuations are considered in Sections 230.11(b) and 230.24 of the Guidelines. Normal water level fluctuations are seasonally cyclical in the Clancy Creek drainage, with higher water levels occurring during spring runoff and lower water levels occurring in late summer, fall, and winter. For EIS Alternative 2, the excavation and removal of 1,800 feet of Clancy Creek, the diversion of flood flows into the mine pit, and the diversion of up to the full flow of Clancy Creek into the mine pit at the conclusion of mining would reduce water levels in Clancy Creek downstream of the M-Pit.

For EIS Alternative 3, Clancy Creek would not be diverted into the mine pit at the conclusion of mining, and water levels in Clancy Creek downstream of the mine pit would not be impacted, except for flood events larger than the design flow. Storm flow greater than the 1 in 20 year return period 24 hour storm event would spill into the mine pit under the EIS Alternative 3 proposed design, and there would be less fluctuation in associated water levels in Clancy Creek during these large flood events.

3.2.4 Salinity Gradients

Salinity gradients are considered in Sections 230.11(b) and 230.25 of the Guidelines. Salinity gradients exist where salt water meets fresh waters. Salinity gradients do not occur for this project.

3.2.5 Actions Taken to Minimize Impacts

Actions that would be taken to minimize adverse effects, as considered in Subpart H of the Guidelines, are discussed in Section 4.0 of this Showing.

3.3 SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS

Suspended particulates in an aquatic ecosystem are considered in Sections 230.11(c) and 230.21 of the Guidelines. Suspended particulates consist of fine-grained mineral and organic particles.

3.3.1 Effects on Suspended Particulates and Turbidity Levels Near the Discharge Site

EIS Alternatives 2 and 3 would affect suspended particulates and turbidity downstream of the M-Pit Mine Expansion and associated excavation of the Clancy Creek channel, and downstream of any construction and wetlands mitigation activities, at the time these activities occur. These impacts would be pronounced during earth moving and may continue as minor impacts for the short term following the disruption until channel banks have stabilized and been revegetated. These impacts would occur at and immediately downgradient from the disturbed site. It is anticipated that the effects would be temporary. As revegetation occurs on stream banks and wetlands, the level of suspended particulates would return to original conditions.

3.3.2 Effects on Chemical and Physical Properties of the Water Column

During the time of mine pit and channel excavation and during construction activities, light penetration through the water channel would be reduced by the increase in sedimentation downstream of the disturbed areas. The sites are in moving waters and reductions in dissolved oxygen are not expected. No toxic metals, organic constituents, or pathogens would be introduced into the Clancy Creek aquatic system as a result of any EIS alternative.

3.3.3 Effects on the Biota

Biota is a term referring to animals, plants, or microorganisms that live within the water column. Impacts related to EIS Alternative 2 related to biota are discussed in detail in Section 3.10.3.2 of the EIS. Impacts related to EIS Alternative 3 related to biota are discussed in Section 3.10.3.3 of the EIS. For EIS Alternative 2, there would be (1) the loss of 1,800 feet of aquatic habitat in Clancy Creek that would be excavated and replaced with a 16-inch-diameter pipe, (2) the loss of connection with habitat in Clancy Creek upstream of the mine pit diversion, and (3) the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek. The pipe would not be an adequate environment to support existing biota. Impacts for EIS Alternative 3 would be less than for Alternative 2 because Clancy Creek would be rerouted to a constructed open-flow channel that mimics the existing channel soon after commencing the M-Pit Mine Expansion, and habitat would remain connected, rather than into a 2,000-foot long, 16-inch diameter high-density polyethylene, thus providing an environment that could potentially support existing biota.

3.3.4 Actions Taken to Minimize Impacts

Actions that would be taken to minimize adverse effects, as considered in Subpart H of the Guidelines, are discussed in Section 4.0 of this Showing.

3.4 CONTAMINANT DETERMINATIONS

The following parameters have been assessed in evaluating the biological availability of possible contaminants in fill material for EIS Alternatives 2 and 3, as considered in Section 230.11(d) of the Guidelines:

- Physical characteristics of the fill material
- Hydrography in relation to known or anticipated source of contamination
- Availability of contaminants

An evaluation of the above information is discussed in detail in Section 3.7 of the EIS. Existing data indicate the concentrations of cadmium, copper, and lead (station SW-16 on Clancy Creek), and cadmium, copper, lead, and zinc (station SW-16B on Clancy Creek) have sometimes exceeded the DEQ-7 acute or chronic aquatic water quality standards. The concentrations of manganese have exceeded the secondary maximum contaminant level (SMCL) at both monitoring stations. These data suggest there is some effect from historic mine drainage or erosion from historic mine workings that may at times enter Clancy Creek upstream of the existing mine pit. In addition, it is not unusual for surface water flowing through areas of high mineralization to exhibit variations in metals concentrations, especially during high flow events characterized by elevated turbidity.

The hillside layback for EIS Alternative 3 possibly could encounter material that could potentially be acid generating (**Figure A-2**). Therefore, as part of EIS Alternative 3, Montana Tunnels would collect operational geochemical data and conduct testing on material from the layback required to construct the Clancy Creek channel to assess potential long-term Clancy Creek water quality issues.

3.5 AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS

3.5.1 Effects on the Aquatic Food Web

An aquatic ecosystem is an intricate structure of different trophic levels involving many types of organisms. The food web of an aquatic ecosystem, as discussed in Sections 230.11(e) and 230.31 of the Guidelines, includes fish populations, periphyton, and macroinvertebrates. Aspects of the food web discussed in detail in EIS Section 3.10, are summarized below.

Clancy Creek was considerably altered by historical mining activities (excavations, roads, vegetation clearing, etc.) and by historical and present-day agricultural practices, primarily livestock grazing and hay production. Beaver dams and ponds, present in the early 1980s along portions of the stream, likely resulted in further alterations to aquatic habitat, such as channel movement and reduced sinuosity. Instream habitat is limited due to the impacts of these past and existing disturbances to the channel and riparian vegetation. Habitat is further limited by the stream's comparatively small size and irregular flow regime. Primary habitat limitations include reduced pool habitat and a lack of in-stream cover features.

Fish

Fish sampling has been periodically conducted in Clancy Creek from 1985 through 2005. Based on this sampling, it appears that the existing Montana Tunnels makeup water diversion intake on Clancy Creek near Kady Gulch is a barrier to upstream fish migration because the fish population structure above this diversion consists of only two species, westslope cutthroat trout and eastern brook trout. Sampling suggests that upstream of this barrier, fish population structure has changed over time in the portion of Clancy Creek from the confluence of Kady Gulch upstream through the vicinity of the proposed M-Pit Mine Expansion area. In general, fewer fish are currently present and the species composition appears to have shifted from predominantly westslope cutthroat trout in 1985 to predominantly eastern brook trout in 2005. However, sampling completed to date does not clearly show a competitive dominance of brook trout over westslope cutthroat trout in Clancy Creek due to the low overall number of individual fish sampled.

Seasonal movement likely accounts for some of the sample variability through time; however, the reduced number of fish could also be a result of altered flows and habitat alterations. Drought conditions, in conjunction with channel alterations resulting from agriculture, construction, and beaver activities, may have disrupted fish distribution and movement, as well as available fish habitat. These alterations may provide a competitive advantage for brook trout in the project reach. Competition with nonnative species, such as brook trout, has led to a reduction in westslope cutthroat trout populations in Montana, but the specific mechanisms involved have not been clearly demonstrated (Griffith 1988).

Periphyton and Macroinvertebrates

Overall, the Clancy Creek drainage supports a high diversity, but relatively low total numbers, of aquatic invertebrates; this condition is similar to other high quality streams in western Montana. Stream health (biotic condition) is typical of other Montana mountain streams.

The percent Chironomidae metric generally increases with a decrease in water quality and generally indicates whether a stream is oligotrophic (nutrient poor) or eutrophic (nutrient rich). Some Chironomidae are relatively tolerant of heavy metals McGuire 1999). Although the metric is higher for Clancy Creek sampling sites compared with the regional value, the values are still relatively low and do not necessarily represent degraded water quality or habitat.

The most common types of aquatic invertebrates found in Clancy Creek are clean-water forms such as mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), representing greater than 40 percent of the total species composition at each sampling site.

Differences between samples within a sampling site were influenced primarily by the available substrate. In general, sites dominated by larger substrate particles (*e.g.*, cobbles) supported a greater percentage of Ephemeroptera (mayflies). Samples dominated by small particles, particularly sand and sediment, tended to have lower diversities but sometimes had greater total numbers of organisms. Differences between samples collected at different sampling sites may reflect the downstream increase in water temperature and general increase in small particle size substrate (sand and sediment).

EIS Alternative 2

For EIS Alternative 2, realignment of Clancy Creek into a pipe during the M-Pit Mine Expansion would result in direct and indirect impacts to fish populations. Under this EIS alternative, 1,800 feet of Clancy Creek channel would be permanently lost, and would result in a long-term reduction of diversity and abundance of aquatic life within the stream.

During the M-Pit Mine Expansion, it is likely that some fish from upper Clancy Creek would become entrained in the pit diversion and lost from the population. The number of fish that would enter the M-Pit during operations would likely be small because only flows greater than 22 cfs (1 in 5 year storm event) would spill into the pit during operation. Following mine closure, a portion of the flow (the volume was not identified by Montana Tunnels) in Clancy Creek would be diverted into the pit lake. Based on pit lake water quality modeling conducted by Montana Tunnels and reviewed by the agencies, it would take decades before M-Pit lake water quality would meet all DEQ-7 aquatic criteria (Montana Tunnels 2007a).

The 2,000-foot-long pipe used to convey Clancy Creek would present a complete barrier to upstream migration of fish in the stream. Approximately 1.5 miles of Clancy Creek is present upstream of the proposed diversion pipe. This section of stream would become isolated from the lower portion of Clancy Creek. The fish population upstream of this

diversion point consists predominantly of eastern brook trout, with small numbers of westslope cutthroat trout.

Sufficient information on life history parameters of the trout population in Clancy Creek is not available to determine if the fish population upstream of the pit would persist if isolated from the rest of Clancy Creek. Due to competition from brook trout and reduced area of available habitat, isolation of this portion of the population may increase the risk of westslope cutthroat trout extinction in the drainage. Habitat upstream of the proposed mine pit diversion is high gradient and lacks deep pools and spawning habitat. Disconnecting the upstream reach of Clancy Creek from the rest of the stream would be a long-term adverse impact to westslope cutthroat trout in Clancy Creek and possibly a long-term adverse impact to eastern brook trout in Clancy Creek.

Short-term adverse impacts on fish in Clancy Creek by channel disturbances and increased fine sediment levels associated with construction and realignment of the Clancy Creek channel are likely to occur. Effects would include temporary displacement of fish from the project area and potential destruction of fish caught in the abandoned channel.

Alternative 2 has the potential to reduce the abundance and diversity of aquatic invertebrates in Clancy Creek through direct loss of aquatic habitat and loss of connectivity with upstream invertebrate populations. Sufficient information is not available to estimate the biomass loss of aquatic invertebrates within the 1,800 feet of Clancy Creek that would be lost under this alternative, because only one sample was collected within the affected reach, which does not represent the range of available habitats. It is unlikely that substantial aquatic invertebrate diversities or densities would develop in the 16-inch, 2,000-foot diversion pipe, and minimal drift from upstream populations would occur through the pipe. The loss of available habitat would result in a short-term reduction in diversity and abundance, but would likely not be sufficient to result in a long-term adverse impact to aquatic invertebrate populations.

Aquatic invertebrate populations would likely shift also in response to habitat changes that would occur for EIS Alternative 2. Construction of wetland features at the intake and outlet of the diversion pipe during operations and diversion of Clancy Creek into the pit lake would result in creation of new habitat, once filling is complete. Wetland and lake environments provide different available habitats for aquatic invertebrate populations and would likely have a slightly different species composition compared with other habitats found in Clancy Creek. The constructed channel downstream of the pipe outlet would present slightly different habitat conditions compared with existing habitat. The constructed channel would be larger and steeper than the existing natural channel, would consist of more uniform substrate, and would lack organic materials, at least in the short term. Rate of aquatic invertebrate colonization in recently disturbed channels can vary greatly, and colonization depends on invertebrate mobility (drift,

swimming, crawling, and flight), substrate texture and associated food supplies, competition, and predation. It is likely that an aquatic invertebrate population would colonize the channel within weeks or months after construction, depending on upstream populations, substrate, and streamflows.

In addition, short-term adverse impacts to aquatic invertebrate populations downstream of the M-Pit Mine Expansion area may occur during realignment and construction of the Clancy Creek channel through increased sediment delivery. The potential short-term increase in fine sediment levels in Clancy Creek would be mitigated through construction BMPs and are not expected to have any long-term adverse impacts on aquatic invertebrate populations.

EIS Alternative 3

Under EIS Alternative 3, Clancy Creek would be rerouted to a constructed open-flow channel that mimics the existing channel soon after commencing the M-Pit Mine Expansion. This would be more beneficial to trout populations than EIS Alternative 2 because it would not result in loss of available habitat, and could result in a long-term improvement to aquatic habitat if the constructed channel consists of enhanced habitat features compared with the existing channel. For EIS Alternative 3, any westslope cutthroat trout in upper Clancy Creek would continue to be at risk of competition with brook trout. It is difficult to quantify this risk, because the status of this population is unclear due to the small numbers of fish sampled in 2003 and 2005. Restoration of the Clancy Creek channel and riparian vegetation would result in a long-term beneficial impact to fish populations in upper Clancy Creek. The existing Montana Tunnels water diversion structure downstream of Kady Gulch, currently functions as a barrier to upstream fish migration. Enhancement of this structure to ensure it remains a barrier in the future would reduce the potential for colonization of upper Clancy Creek by more introduced fish species. Maintaining this barrier would allow for potential restoration of the westslope cutthroat trout population, including active removal of brook trout if necessary, to occur in the future.

The length of time for aquatic invertebrates to colonize newly available habitat varies depending on distance from existing populations and channel conditions, but it is likely that a diverse population of aquatic invertebrates would colonize the new channel relatively quickly (weeks to months). For EIS Alternative 3, habitat conditions would be present that are more appropriate for aquatic invertebrate populations typical of headwater streams, and a long-term beneficial impact is expected.

3.5.2 Effects on Special Aquatic Sites

Certain special aquatic sites as defined and considered in Subpart E, Sections 230.40 – 230.45 that could be impacted include wetlands. Riffle and pool complexes, vegetated

shallows, sanctuaries and refuges, mud flats, and coral reefs are not observed in the project area or considered further in this Showing.

Wetlands (Section 230.41). A total of 2.64 acres of wetland would be impacted of which 2.11 acres would be directly impacted and 0.53 acres indirectly impacted. **Table A-1** provides a summary of wetland type and acreages impacted by EIS Alternatives 2 and 3. Impacts to wetlands are discussed in detail in Section 2.1.3 of this Showing.

3.5.3 Effects on Threatened or Endangered Species

Project impacts related to plants and animals listed as threatened or endangered under the ESA are considered in Section 230.30 of the Guidelines. There are no known occurrences of any federally listed or proposed plant species within the proposed project vicinity. The occurrence of threatened or endangered animal species is discussed in detail in Section 3.9 of the EIS, and is summarized below.

Bald Eagle – Threatened

On June 28, 2007 the bald eagle was removed from the list of threatened and endangered species (USFWS 2007). To ensure that eagles continue to thrive, the USFWS will work with Montana Fish, Wildlife and Parks (FWP) to monitor eagles for at least five years. Nesting and wintering eagles can be found along the Missouri River, at least 23 miles east of the Montana Tunnels Mine. Although transient bald eagles might occasionally fly over the project area, habitat for bald eagles is not present. There is a potential that they could forage on waterfowl on the tailings impoundment during operations.

Gray Wolf – Endangered

In Jefferson County and Lewis and Clark County, the gray wolves are considered an endangered, nonessential experimental population. West of Interstate-15 and within the project area, the gray wolf is currently listed as endangered.

While there are no known wolf packs in the vicinity of the Montana Tunnels Mine, transient individuals may pass through the area. FWP reported the gray wolf has been recorded in the Occidental Plateau area, just west of Montana Tunnels during or prior to 2002. The nearest known wolf pack is the Spotted Dog pack, south of Avon, Montana, approximately 25 miles northwest of the project area.

Grizzly Bear – Threatened

The grizzly bear is not listed in Jefferson County, although it is listed for Lewis and Clark County. The Northern Continental Divide Ecosystem Recovery Zone (NCDE) is the nearest population of grizzly bears, approximately 43 miles northwest of Montana Tunnels. In recent years, grizzly bears have been expanding their range outside of the recovery zone. The distribution of grizzly bears south of the NCDE is approximately 25 miles north of the Montana Tunnels Mine. Transient grizzly bears could move through the vicinity of the mine. FWP reported that a grizzly bear was observed 10 miles west of the mine, in the Basin Creek area. This area is also in the vicinity of the Continental Divide, which is identified as a potentially important movement corridor for wildlife, including grizzly bears. Linkage areas facilitating the movement of individuals between populations are important to recovery of the grizzly bear.

Canada Lynx – Threatened

The Clancy Creek portion of the proposed Montana Tunnels M-Pit Mine Expansion is considered to be within Canada lynx range. The Montana Tunnels existing permit area is at the lower limit of the reported distribution of lynx habitat east of the Continental Divide (approximately 6,000 feet elevation). The habitat types within the expansion area are not considered preferred habitat for lynx, although lower elevation coniferous and shrub-steppe habitat may provide linkage to primary habitats.

There are no known resident lynx in the vicinity of Montana Tunnels, and there are no recent or historic accounts of denning or reproduction near Montana Tunnels. Lynx are highly mobile and capable of dispersing long distances across habitats generally considered.

3.5.4 Effects on Other Wildlife

Effects resulting from altered habitats (mine pit, facilities, tailings storage facility), including reclaimed sites, would persist. Excavation of the mine pit reduced wildlife habitat in the permit area, and the quality of wildlife cover in reclaimed lands has been lowered due to reduced densities of shrubs and conifers. Some animals, however, may benefit from the increased acreage of foraging habitat. Impacts to wildlife from implementation of EIS Alternatives 2 and would be additive to those that have already occurred. Impacts primarily would be a result of additional loss of wildlife habitat. Additional habitat would be lost through expansion of the M-Pit.

3.5.5 Actions Taken to Avoid and Minimize Impacts

Actions that would be taken to avoid and minimize adverse effects, as considered in Subpart H of the Guidelines, are discussed in Section 4.0 of this Showing.

3.6 PROPOSED DISPOSAL SITE DETERMINATIONS

Waste rock and tailings would not be stored within jurisdictional wetlands or other Waters of the U.S. There are no proposed disposal sites as considered in 230.11(f) of the Guidelines. Impacted wetlands would be mitigated prior to mine expansion, if possible. Soils from the mitigation site, including hydric soils from existing wetlands and deep loams suitable for supporting hydrophytic vegetation, would be salvaged from and redistributed on the mitigation site.

3.6.1 Mixing Zone Determinations

As stated above, there are no disposal sites associated with EIS Alternatives 2 and 3, and therefore, no mixing zones.

3.6.2 Actions Taken to Minimize Adverse Discharge Effects

Actions that would be taken to avoid and minimize adverse effects, as considered in Subpart H Sections 230.70 to 230.77 of the Guidelines, are discussed in Section 4.0 of this Showing.

3.6.3 Determination of Compliance with Applicable Water Quality Standards

Montana water quality standards are specified numerically in Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2006), as a combination of human health and aquatic life criteria. Applicable narrative standards for Clancy Creek include: maximum allowable increase in naturally occurring turbidity (5 nephelometric turbidity units); and no increases above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which would or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife (Administrative Rules of Montana [ARM] 17.30.723). Montana rules also encompass a "nondegradation policy" to prohibit the degradation of high quality surface water and groundwater (ARM 17.30.701-717; MCA 75-5-301, 303 and 306).

Impacts to water quality of Clancy Creek are discussed in detail in Section 3.7 of the EIS. The excavation and removal of the Clancy Creek stream channel and construction of planned diversion structures and constructed stream channels in the Clancy Creek drainage under EIS Alternatives 2 and 3would likely result in a temporary increase in soil erosion and associated load in total suspended solids (TSS) to Clancy Creek during the construction period, even if BMPs were utilized. The potential increase in TSS cannot be quantified and depends on the effectiveness of BMPs. The impact would persist until revegetation of the area was complete.

3.7 POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

Aquatic systems can provide a variety of uses to humans, as considered in Subpart F, Sections 230.50 – 230.55 of the Guidelines.

3.7.1 Municipal, Private, and Potential Water Supply (Section 230.50)

Regulation of surface water and groundwater use within the State of Montana is required by the Montana State Constitution, Article IX, Section 3(3). Montana follows the water right doctrine of prior appropriations. Montana Tunnels currently holds water rights for 2,244 gpm (5 cfs) at a point of diversion on Clancy Creek upstream of the pit with a January 1 to December 31 period of use, and priority date of 1872, more than enough to appropriate the full flow of Clancy Creek at the location of the mine pit for all reasonably anticipated base flow conditions. The priority date of this senior water right minimizes the potential to impacts downstream water rights.

Montana Tunnels currently diverts 0.56 cfs of surface water from Clancy Creek at a point of diversion located near the confluence with Kady Gulch to satisfy mill makeup water requirements. Montana Tunnels also maintains a pump station on lower Clancy Creek and currently diverts 2.2 cfs of surface water for mill makeup. After mining ceases, these appropriations of surface water would no longer occur, and the additional water would be available for other uses, assuming the Montana Tunnels water right is not used for another purpose.

3.7.2 Recreational and Commercial Fisheries (Section 230.51)

Clancy Creek in the vicinity of the proposed project is not considered a commercial fishery. Although there is a recreational fishery, the stream does not appear to be highly utilized. Impacts to fish habitat and populations related to mine expansion, excavation of Clancy Creek, and associated construction activities are discussed in detail in Section 3.5 of this Showing.

3.7.3 Water-related Recreation (Section 230.52)

Recreational activities such as rafting, canoeing, and kayaking are not associated with Clancy Creek. Observed recreational activities include camping and fishing. While the natural beauty of the Clancy Creek drainage would be forever changed, revegetation and reforestation efforts would diminish the long term effect of this impact.

3.7.4 Aesthetics of the Aquatic Ecosystem (Section 230.53)

Aesthetic qualities of the wetlands and Waters of the U.S. would be impacted by EIS Alternatives 2 and 3. As defined in the Guidelines, "aesthetics of aquatic ecosystems apply to the quality of life enjoyed by the general public and property owners." The

project would impact the aesthetic quality of the area and visual resources, particularly during mine expansion, excavation, and removal of the existing Clancy Creek channel, and construction of the wetlands mitigations-site. Some impacts would be long term, such as the landscape changes caused by M-Pit Mine Expansion and associated hillside layback (**Figure A-2 and Figure A-7**). The visual impacts of viewing the mine pit would depend on the time of year and the visual orientation of the viewer. Revegetation and reclamation activities would reduce the level of impacts to the aesthetic quality of this area.

3.7.5 Federal and State Preserves (Section 230.54)

There are no parks, national or historical monuments, national seashores, wilderness areas, research sites, or similar preserves within the permit boundary of the proposed project.

An intensive cultural resource inventory of the proposed M-Pit Mine Expansion area was conducted on an irregularly shaped parcel of land in Township 7N Range 4W, containing 185 acres. The inventory resulted in the relocation of one previously recorded miner's camp, and the identification and recordation of four previously undocumented historic-era properties (Ferguson 2003).

For purposes of assessing the environmental consequences, it is usually the case that only "historic resources," *i.e.*, properties determined "eligible" for, or listed in, the National Register of Historic Places (National Register) are considered. Cultural resources that have been documented and evaluated and determined "not eligible" for listing in the National Register are generally eliminated from the assessment of effect. There currently is no formal consensus determination of eligibility for the five properties potentially "eligible" for listing located within the proposed permit expansion area.

3.7.6 Actions Taken to Minimize Impacts

Actions that would be taken to avoid and minimize adverse effects, as considered in Subpart H Sections 230.70 to 230.77 of the Guidelines, are discussed in Section 4.0 of this Showing.

3.8 DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM

Cumulative effects, as considered in Section 230.11(g) of the Guidelines, are collective impacts of the proposed project considered with impacts from past, present, and reasonably foreseeable projects. A determination of the cumulative effects on the aquatic ecosystem in presented in detail in Section 4.1.9 of the EIS. Projects considered for the cumulative analysis included (1) subdivisions in the immediate Montana

Tunnels area, (2) Elkhorn Goldfields' proposed Golden Dream Project, (3) reclamation of abandoned mines in the area, and (4) possible closure of the Golden Sunlight Mine.

The cumulative impact of subdivisions on aquatic resources and fish populations in the Prickly Pear Creek drainage area would depend on the effects to stream habitat, water quality, and water quantity. The potential change would be difficult to determine because the exact location and extent of future activities is unclear. Implementation of BMPs during construction, timber management activities, and during road construction and maintenance should minimize impacts to aquatic habitat.

3.9 DETERMINATION OF SECONDARY EFFECTS ON THE AQUATIC ECOSYSTEM

Secondary effects on Waters of the U.S., as considered in Section 230.11(h) of the Guidelines, are impacts that occur that are not directly related to mine expansion and related wetland and stream channel mitigation activities. Sedimentation from surface runoff in disturbed areas and the spread of noxious weeds from traffic activities are potential secondary impacts. These secondary impacts could be reduced by implementation of BMPs and other mitigation efforts, as described in Section 2.1.4 of this Showing.

4.0 ACTIONS TO MINIMIZE ADVERSE EFFECTS - (SUBPART H, SECTIONS 230.70-230.77)

Actions to be taken to minimize adverse effects on Waters of the U.S. have been developed by Montana Tunnels and the regulatory agencies as mitigation measures through the NEPA/MEPA process, are included in EIS Alternative 3, and are described in detail in Chapter 2 of the EIS. Actions to minimize adverse effects are described below.

Montana Tunnels would employ a number of best management construction methods to help prevent erosion and decrease sedimentation during construction activities. Methods may include using silt fencing wherever appropriate, diverting water flows around work areas, suppressing dust emissions during dry periods, and salvaging hydric soils in the wetlands mitigation area for use in revegetation operations.

A wetlands mitigation plan has been prepared by Montana Tunnels (Montana Tunnels 2007a). The wetlands mitigation plan is also summarized in Section 3.8 of the EIS and discussed in the various sections of this Showing.

4.1 ACTIONS CONCERNING THE LOCATION OF THE DISCHARGE (SECTION 230.70)

Montana Tunnels evaluated five alternative Waters of the U.S. mitigation sites in 2005. The five sites included two on or near Pen Yan Creek, two on Spring Creek (upper and

lower) and one on Clancy Creek. The Corps of Engineers found the Pen Yan Creek sites to be “not suitable” because of steep slopes on the upper reach of the Creek, loss of high quality upland habitat and poor water quality from historic mine drainage.

The Corps of Engineers also expressed doubt that forested wetland impacted on Clancy Creek could be replaced in a reasonable time period on the lower Spring Creek site. The upper Spring Creek site was considered to have good potential for stream mitigation but, because of existing wetlands at the site. The Corps of Engineers questioned whether sufficient area existed for wetland creation in upper Spring Creek.

The Corps of Engineers considered the Clancy Creek site to have fair potential for wetland creation and presented an opportunity to reestablish a stream channel. Based on the review of the alternative mitigation sites by the Corps of Engineers, and additional analysis by Montana Tunnels, Montana Tunnels proposes to use the Clancy Creek site as the preferred location to mitigate wetland and stream impacts (**Figure A-3**).

4.2 ACTIONS CONCERNING THE MATERIAL TO BE DISCHARGED (SECTION 230.71)

Montana Tunnels prepared a wetlands mitigation plan. This plan states that a total of 2.64 acres of wetland would be impacted of which 2.11 acres would be directly impacted and 0.53 acres indirectly impacted (**Table A-1**). Montana Tunnels indicated that a basic assumption for proposed mitigation is a mitigation ratio of 1:1 based on Corps of Engineers policy for mitigation established and viable prior to project impact.

The overall goal of Montana Tunnels’ compensatory mitigation plan is to provide no net loss of wetlands that would be affected by the proposed expansion of the Montana Tunnels Mine. Specific goals include:

- Create not less than 3.00 acres of wetland based on an affected area of 2.64 acres (2.11 acres of direct impacts and 0.53 acre of indirect impacts). Proposed mitigation ratios (**Table A-4**) are based on the assumption that emergent and scrub/shrub wetlands would be established and viable prior to project impact (1:1 ratio). The mitigation ratio for forested wetlands (1.5:1) assumes that wetlands would be established but not viable prior to project impacts;

- Replace the 2.13 acres of existing wetlands that would be affected in the mitigation area at a ratio of 1:1;

- Replace vegetation types (emergent, scrub-shrub and forest) in generally the same ratio as those impacted (5-15 percent emergent; 60-70 percent scrub-shrub; 25-30 percent forest);

- Achieve comparable functions and values between the mitigation site and affected wetlands; and

- Construct stream channels in suitable locations to replace channels removed by mining activities.

Table A-4 provides a summary of wetland disturbance acreage by vegetation type, proposed mitigation ratios and mitigation acreage for EIS Alternatives 2 and 3.

Mitigation prior to impacting wetlands precludes the salvage and redistribution of hydric soils from the mine expansion area for use in the mitigation area. Soils from the mitigation site including hydric soils from existing wetlands and deep loams suitable for supporting hydrophytic vegetation would be salvaged from and redistributed on the mitigation site. With establishment of wetland hydrology, these soils would develop hydric characteristics.

Hydric soils from the mine expansion area would be salvaged and redistributed adjacent to the reestablished channel if EIS Alternative 3 is implemented. If the permitting and mine expansion schedules do not allow for mitigation prior to wetland impact, hydric soils from the impact area would be used on the mitigation site.

Not less than two feet of suitable plant growth material (subsoil) salvaged from the mitigation site would be placed over the low permeability liner prior to redistributing soil. Approximately 12 inches of salvaged soil would be placed over the subsoil.

Respread soils would be decompacted as necessary by ripping or chisel plowing, depending on depth of compaction. Disking and harrowing would be conducted to prepare a proper seedbed.

Surface flows in Clancy Creek would be evaluated by completing a water budget to ensure flows are adequate to support created wetlands. The full flow of upper Clancy Creek would be conveyed around the M-Pit to the wetlands mitigation site. Construction of an impermeable layer under the replacement wetlands area would further reduce stream water loss within the mitigation area. During construction of the mitigation site, flow in Clancy Creek would be maintained by piping or constructing a temporary channel along the edge of the site. This would insure that downstream flows and wetland hydrology are maintained. Water quality in Clancy Creek would be protected by installing appropriate BMPs including installation of silt fence and other BMPs between the mitigation area and the downstream undisturbed area.

4.3 ACTIONS CONTROLLING THE MATERIAL AFTER DISCHARGE (SECTION 230.72)

The Montana Tunnels wetlands mitigation plan specifies the need for future site protection, stating that the wetlands mitigation site would be protected in perpetuity. The mitigation site area is currently owned by Montana Tunnels. The site would be encumbered by a conservation easement and managed per recorded property deed restrictions (Montana Tunnels 2007b). All wetland within the site would remain in a natural state. No clearing, vegetation removal, grading, filling, or construction of any kind would be conducted within this area. Exceptions to this might include emergencies for the protection of public health, safety, and resources. Any disturbance of vegetation that might occur during such emergency activities would be repaired.

4.4 ACTIONS AFFECTING THE METHOD OF DISPERSION (SECTION 230.73)

Montana Tunnels' wetlands mitigation plan specifies that conditions for seasonal saturation or shallow inundation (less than 6 inches) would be created by modifying the existing topography and utilizing flows from Clancy Creek. **Figure A-9** shows a typical cross section to create suitable conditions for wetland establishment. Topography would be modified by grading the existing wetland and upland areas within the mitigation site to create level to very gently sloping terraces with inflow control, containment berms, and controlled outlets.

Soil and subsoil would be excavated and the site contoured to proper grade to ensure wetland hydrology. Since Clancy Creek is a losing stream within the mitigation site, it is anticipated that a low permeability barrier (liner) would be necessary under the entire mitigation site.

Low permeability substrates or commercially available aquatards would be placed below respread soils to reduce vertical water loss. Natural or imported substrates must have a USDA soil permeability class of very slow, slow or moderately slow (less than 0.60 inch per hour) and contain not less than 50 percent clay. Incorporation and compaction of clay to achieve a permeability of not less than 0.0014 inches per hour would reduce downward water loss.

The low permeability material would be graded at designated locations to install berms to create saturated conditions in overlying soils. Berms would be protected by armoring with rock (colluvium, alluvium or riprap) prior to resoiling.

4.5 ACTIONS RELATED TO TECHNOLOGY (SECTION 230.74)

A detailed discussion of stream channel mitigations and design features for EIS Alternative 3 were provided in Section 1.2.4 of this Showing. In summary, for EIS Alternative 3 none of the flow of Clancy Creek would be diverted to the pit at the

conclusion of mining. Instead a realigned constructed open-flow channel would permanently convey surface water and groundwater of upstream Clancy Creek and the ephemeral drainage around the mine pit soon after commencing the M-Pit Mine Expansion. More water (estimated annualized flow equal to 100 gpm [0.22 cfs]) would be available in Clancy Creek downstream of the mine pit for EIS Alternative 3. EIS Alternative 3 also provides potential for some additional wetlands and aquatic habitat to naturally reestablish along the full length of the reconstructed Clancy Creek channel.

4.6 ACTIONS AFFECTING PLANT AND ANIMAL POPULATIONS (SECTION 230.75)

All plant populations in the mine expansion area would be lost, while animal populations would be displaced or lost as a result of construction activities associated with the wetlands mitigation site. Reclamation activities would, upon completion, replace some of the lost habitat and provide for the reestablishment of some of the lost plant and animal populations. In addition, in the event a 404 permit is approved and issued, permit conditions and additional mitigation measures may be incorporated into the 404 permit to ensure the project complies with Section 230.10(d) of the guidelines. Montana Tunnels has proposed wetlands mitigation to offset adverse impacts and provide reasonable mitigation for the loss of wildlife habitat.

Structural and biological diversity would be created by planting and seeding species of different morphological classes (herbaceous, shrubs, and trees). Trees would be planted to provide a forested wetland over 25 to 30 percent of the mitigation area, primarily along the stream channels. Shrubs would be planted to create a scrub/shrub wetland on 60 to 70 percent of the mitigation area, and herbaceous species would be seeded on 5 to 15 percent of the site, primarily on those areas expected to be saturated for the longest time during the growing season. Each vegetation type would have a mix of several species to increase diversity. Herbaceous species would be included in each mix to provide initial site stabilization and erosion control.

Table A-5 provides a list of the species to be included in the three revegetation mixes, with the addition of other site-adapted species as necessary.

Trees and shrubs would be planted using containerized stock except for willows which may be established from cuttings. Herbaceous species would be seeded using noxious-weed-free seed suitable to the geographic area.

Planting rates would be designed to achieve performance standards identified in **Attachment A-3**. Initial tree planting density would be 400 trees per acre. Initial shrub planting density would also be 400 stems per acre. Seed mixes would be designed to apply 50 to 75 pure live seeds per square foot (PLS/ft^2) for drill seeding and 75 to 100 PLS/ft^2 for broadcast seeding.

Cultural treatments would be implemented as necessary to promote vegetation establishment and growth. These treatments may include: 1) discing or harrowing to provide a proper seedbed; 2) mulching; 3) fertilizing; 4) protecting planted materials from herbivory; and 5) controlling noxious or other undesirable weeds that may compromise revegetation success. Noxious weeds would be controlled in accordance with Jefferson County requirements.

New vegetation growth along stream banks would produce some shading and habitat for aquatic life during the first growing season with much greater vegetation density increases in subsequent growing seasons. Willows, trees, and other shrubs planted along reestablished channels would grow rapidly in the water rich soil providing incremental streamside shading.

4.7 ACTIONS AFFECTING HUMAN USE (SECTION 230.76)

Little can be done to change the impact the project would have on human use. The Montana Tunnels wetlands mitigation plan specifies the need for future site protection. Section 4.3 of this Showing discusses the need for a conservation easement.

4.8 OTHER ACTIONS (SECTION 230.77)

A contingency plan would be prepared and implemented, if necessary, to address unforeseen or uncontrollable circumstances such as altered site hydrology, stream channel instability, or lack of revegetation success (Montana Tunnels 2007b). Contingency measures would be based on specific conditions and implemented in consultation with the appropriate regulatory authority. Actions to be taken in the event of unexpected conditions would be based on mitigation goals and objectives and performance standards. Contingency measures may include modifications to performance standards if mitigation is meeting goals in unanticipated ways (Corps of Engineers Regulatory Guidance Letter 02-2, December 24, 2002).

The Montana Tunnels' wetlands mitigation plan includes monitoring of compensatory mitigation sites. Specifically, the compensatory mitigation sites would be monitored for three years following completion of mitigation activities. Monitoring would be conducted during the first and third growing seasons by a qualified wetland biologist.

Monitoring would be designed to determine if the mitigation site is achieving the performance standards specified in **Attachment A-3**. Permanent transects and photo points would be established for data collection. Transects and photo points would be located using Global Positioning Systems (GPS) and depicted on a map. The total number of transects and density of measuring points per transect would be determined once site configuration is finalized. A monitoring report would be prepared detailing monitoring results. In addition to presenting monitoring data, the report would specify

any corrective measures that may be implemented to insure that goals and objectives are met. The specific project components that would be monitored include the water regime, soils, vegetation, wetlands functions and values, and the stream channel. These monitoring components are described in detail below.

Water Regime

The water table would be measured along each transect to determine if water levels meet the objectives specified in **Attachment A-3**. The water table elevation would be determined from 2-foot-long, 1-inch-diameter piezometers buried approximately 23 inches in the ground. Water levels would be measured with a water level meter lowered into each well. A spring/summer survey would be scheduled such that it can be determined if the site is saturated within 12 inches of the surface or inundated to a depth of not more than 6 inches for at least 22 days during the growing season. The number of wells per transect would be determined once mitigation activities are completed.

Soils

The hydric nature of soil within the site would be verified by seasonal saturation or inundation for 22 days during the growing season. If the hydric nature of a soil is in question, soil sample pits would be dug to determine whether hydric soils exist.

Vegetation

Vegetation would be surveyed at 0.01-acre plots spaced along each transect. The number of plots would be based on final mitigation site design. The following parameters would be recorded at each site:

- Percent cover of dominant species;
- Percent cover by morphological class;
- Percent bare ground;
- Percent litter (*e.g.* twigs, dead grass, branches);
- Total non-stratified cover (not to exceed 100 percent);
- Shrub and tree density by species.

In addition, planted shrubs and trees would be marked and their survival rate calculated for each monitoring period.

Functions and Values

A functional assessment of the mitigation site would be conducted during the third growing season using MDT's Montana Wetland Assessment method (Berglund 1999).

Stream Channel

Reestablished stream channels would be monitored annually for 3 years immediately following spring runoff to assess bank stability and overbank flooding to reestablish wetlands. Channels would also be monitored following any high-intensity rainfall/runoff events.

5.0 PRELIMINARY CONCLUSIONS

The proposed Montana Tunnels M-Pit mining project has been reviewed relative to the Section 404(b)(1) Guidelines and the agencies have concluded the mining project would result in impacts to circulation and fluctuation patterns, substrate, suspended particulates/turbidity, water quality, and aquatic ecosystem structure and function. Several of these impacts would be permanent and long-term (*e.g.*, mine expansion and excavation of 1,800 feet of the existing Clancy Creek channel) while others would occur primarily during the construction period and would be short-term (*e.g.*, water quality impacts during construction of the wetlands mitigation site). Cumulative effects from other potential activities such as planned subdivisions and new mining projects would be evaluated and considered prior to making the final permitting decision.

In the Corps of Engineers review of the project, all the alternatives considered in the EIS would be reviewed and evaluated to determine if there is a least damaging practicable alternative that could be permitted. Public interest factors, input from other state and federal agencies, and the proposed mitigation measures would also be considered by the Corps of Engineers in the evaluation process prior to their making a final permitting determination.

At the earliest, a final 404 permit evaluation cannot be made by the Corps of Engineers until 30 days after the final EIS is published.

6.0 REFERENCES

Berglund, J. 1999. MDT Montana wetland assessment method. Prepared for Montana Department of Transportation and Morrison-Maierle, Inc. by Western EcoTech, Helena, MT.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Biological Services Program; U.S. Fish and Wildlife Service FWS/ OBS-79/31. USGPO. Washington, D.C

Environmental Laboratory. 1987. Corps of Engineers wetland delineation manual. Technical Report Y-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Ferguson, David. 2003. A Class III Cultural Resources Inventory of the Apollo Gold/Montana Tunnels Proposed Permit Expansion Area, Jefferson County, Montana. GCM Services, Inc., for Apollo Gold, Inc.

Montana Department of State Lands (DSL). 1985. Draft Environmental Impact Statement, Montana Tunnels Project. Helena, MT.

DSL. 1986. Final Environmental Impact Statement, Montana Tunnels Project. Helena, MT. January.

Montana Department of Environmental Quality (DEQ). 2006. Montana Numeric Water Quality Standards. Circular DEQ-7 Montana Numeric Water Quality Standards. February.

Montana Tunnels Mining, Inc. (Montana Tunnels). 2007a. M-Pit Mine Expansion Application, Last Revised in 2007. The revised application includes all original documents and updates (see Section 9.0 of EIS for listing).

Montana Tunnels. 2007b. Montana Tunnels M-Pit Expansion Conceptual Compensatory Wetlands Mitigation Plan for Clancy Creek. February.

U.S. Army Corps of Engineers. 2002. Regulatory Guidance Letter 02-2. Available on line at: http://www.usace.army.mil/cw/hot_topics/ht_2002/RGL_02-2.pdf**.**

U.S. Fish and Wildlife Service. 2007. U.S. Fish and Wildlife Ecological Services – Bald Eagle. Available on line at: http://www.fws.gov/midwest/eagle.

WESTECH Environmental Services, Inc. 2006. Wetlands Inventory Montana Tunnels Mine Expansion, Jefferson County, Montana. September.

TABLES

TABLE A-1

Wetland Type And Acres Impacted By M-Pit Mine Expansion For EIS Alternative 2 And Alternative 3

Wetland Type (Cowardin Class)	Clancy Creek Wetland Impacts		
	Direct (acres)	**Indirect (acres)**	**Total (acres)**
PEMA	0.216	0	0.216
PSSA/PEMA	0.037	0.05	0.087
PSSC	1.152	0.106	1.258
PSSC/PFOC	0.354	0	0.354
PFOC	0.348	0.37	0.718
TOTALS	**2.107**	**0.526**	**2.633**

Notes:

PEMA Palustrine emergent (temporarily flooded)
PSSA Palustrine scrub-shrub (temporarily flooded)
PSSC Palustrine scrub-shrub (seasonally flooded)
PFOC Palustrine forested (seasonally flooded)

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Disturbed Acreage Waste Rock Storage Areas	425.9 acres	579.1 acres	579.1 acres
Cap Rock and Low Grade Stockpiles	66 acres	68.3 acres	68.3 acres
South Pond and Tailings Storage Facility Embankment Top	22.7 acres	24.7 acres	24.7 acres
Tailings Storage Facility	259.3 acres	272.6 acres	272.6 acres
Open Pit	248.4 acres	287.7 acres	287.7 acres
Pit Perimeter	16 acres	11.1 acres	54.2 acres
Facilities	37.6 acres	37.6 acres	37.6 acres
Gravel Pit Area	33.1 acres	0.0 acres	0.0 acres
Soil and Gravel Stockpiles	59.6 acres	115.3 acres	115.3 acres
Roads and Miscellaneous	30.9 acres	55.8 acres	55.8 acres
Total Acres	**1,199.5** acres	**1,452.2** acres	**1,489.1** acres
Geology and Minerals	Mining continues through 2009. L-Pit mine (248.4 acres); waste rock stored in a 425.9 acre waste rock storage area; milled ore wastes deposited in a 259.3 acre tailings storage facility.	Mining continues through 2013. Larger (+16%) M-Pit mine, larger waste rock storage area (+36%) and larger (+5%) tailings storage facility.	Same as Alternative 2 except waste rock volume would increase from the hillside layback.
	No hillside layback required to reroute Clancy Creek.	Same as Alternative 1.	A 36.9-acre layback of the hillside northwest of the mine pit adjacent to Clancy Creek would be required to route the creek into a constructed open-flow channel.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geotechnical Engineering	Erosion of the L-Pit highwalls and raveling of material onto benches would occur. Potential for smaller scale slope failures on pit highwalls and release of rock into the L-Pit similar to the failures that have previously occurred during operations.	Similar to Alternative 1, except that M-Pit Mine Expansion would expose weaker rock within some of the highwall resulting in more potential minor highwall instability problems.	Similar to Alternative 2, except that a higher level of blasting control would be used to minimize potential stability problems with the M-Pit highwall.
	The Clancy Creek channel would not be disturbed.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a 2,000-foot pipe around the M-Pit.	For increased stability, Clancy Creek would be routed to a constructed open-flow channel which would require a 36.9-acre layback of the hillside near the M-Pit. Appropriate operational and geotechnical measures would be implemented to achieve and maintain stability of the relocated Clancy Creek channel.
	A maximum waste rock storage area lift height of 50 feet would be used during construction to improve compaction.	A maximum waste rock storage area lift height of 150 feet would be used during construction.	Same as Alternative 1.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Soil, Vegetation, and Reclamation	Soil impacts result from the removal, storage, and replacement of soil during mining and include loss of soil development and horizonation, soil erosion from the disturbed areas and stockpiles, reduction of favorable physical and chemical properties, reduction in biological activity, and changes in nutrient levels. The degree or level of impacts determines, in part, the potential success of reclaiming the areas to forested areas, grasslands, and wildlife habitat. Ongoing reclamation has successfully reestablished a grassland vegetation cover.	Soil and vegetation impacts would be similar to those described under Alternative 1 but would apply to a larger area of disturbance. Soil would be salvaged from an additional 540 acres for a total disturbance of 1,452.2 acres. Soil would be redistributed on an additional 191 acres for a total of approximately 941 acres. The revegetation plan for Alternative 2 contains the same seed mixtures and plant communities as Alternative 1.	Similar to Alternative 2, except the sides of the waste rock storage areas would be regraded with concave slopes and a dendritic drainage pattern.
	The Clancy Creek channel would not be disturbed.	Clancy Creek in the vicinity of the M-Pit would be routed in a combination 2,000-foot-long pipe and 600-foot lined channel, and a wetlands mitigation plan would be implemented along Clancy Creek downstream of the M-Pit.	Similar to Alternative 2, except Clancy Creek would be routed in a constructed open-flow channel that would be designed to mimic the existing stream channel.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Geochemistry	Waste rock and ore mined under the Alternative 1 (L-Pit) and Alternative 2 (M-Pit) plans would behave similarly from a geochemical perspective. Static acid-base accounting (ABA) testing suggests the potential for acid generation from ore and waste rock exists, especially for materials excavated from depths below 5,100 feet. These data are conservative as shown by kinetic tests that consistently fail to produce acid from samples classified as acidic based on ABA data and a history of 20 years of mining which has not produced acid. Acid generation is not predicted.	Similar to Alternative 1 except that as the M-Pit deepens the potential for acid generation may increase.	Similar to Alternative 2 except that ore and waste rock encountered at depth would be further evaluated through an operational geochemical verification program that includes a more detailed sampling plan and kinetic testing.
	The L-Pit lake is predicted to have elevated concentrations of iron, sulfate and cyanide for about a decade after pit filling begins, and manganese is predicted to exceed the SMCL for almost two centuries.	The M-Pit lake is predicted to have elevated concentrations of cadmium, sulfate, and cyanide for about a decade, and manganese is predicted to exceed the SMCL for about two centuries.	Same as Alternative 2.
	Waste rock has the potential to release manganese.	Same as Alternative 1.	Same as Alternative 1 except that an alternative waste rock handling program would be implemented, if necessary.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Geochemistry (Cont.)	Tailings have the potential to release iron, manganese, sulfate and cyanide.	Same As Alternative 1.	Same as Alternative 1, except that an alternative tailings facility closure plan would be implemented as follows:
			(1) Montana Tunnels would conduct kinetic oxidation tests to evaluate these possible changes for the existing tailings, for the tailings with M-Pit Mine Expansion material included, and for the tailings with M-Pit combined with Elkhorn Goldfields material. If these tests indicate differences from water chemistry predicted in this EIS, alternative capping strategies for tailings would be considered to limit oxygen flux and neutralize any acidity resulting from oxidation.
			(2) If Elkhorn Goldfields tailings are found to generate acid or produce elevated metals concentrations, Montana Tunnels would either refuse to mill Elkhorn Goldfields ore or would construct a separate tailings storage facility to segregate the tailings from material in the existing tailings storage facility. This new facility would have to be analyzed and approved in another environmental analysis.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Groundwater	Groundwater would flow into the L-Pit for almost two centuries, and would create a post-mining pit lake about 1,360 feet deep (L-Pit lake equilibrium surface at 5,610 feet minus the pit bottom at 4,250 feet). The L-Pit would not completely fill. Seepage from the L-Pit (7 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Groundwater would flow into the M-Pit for about two centuries, and would create a post-mining pit lake about 1,575 feet deep (M-Pit lake equilibrium surface at 5,625 feet minus the pit bottom at 4,050 feet). The M-Pit would not completely fill. Seepage from the M-Pit (at least 360 gpm) would eventually recharge groundwater in the Spring Creek drainage.	Similar to Alternative 2, except that seepage from the M-Pit to groundwater in the Spring Creek drainage would be less because there would be no surface water inflow to the mine pit from Clancy Creek.
	After mining ceases, runoff from the reclaimed tailings surface and tailings storage facility seepage would be routed to the percolation pond created in the reclaimed south pond, and then infiltrated to groundwater in the Spring Creek drainage.	After mining ceases, runoff from the reclaimed tailings surface would be routed to the M-Pit. Tailings storage facility seepage would be routed the same as in Alternative 1.	Same as Alternative 2, except if there are elevated concentrations of metals or cyanide in the tailings storage facility seepage, seepage would be managed or treated until it can be discharged to the percolation pond as in Alternatives 1 and 2.
	Seepage from the waste rock storage area would infiltrate to the Spring Creek drainage.	Same as Alternative 1.	Same as Alternative 1.
	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase.	The concentrations of sulfate, iron, and manganese in groundwater downgradient of the mine facilities would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Groundwater (Cont.)	The Clancy Creek alluvium and aquifer would not be disturbed.	Approximately 1,800 linear feet of alluvium and aquifer associated with Clancy Creek on the northwest side of the mine pit would be excavated and removed.	Same as Alternative 2.
	No operational verification program of L-Pit lake water quality or seepage from the tailings storage facility would be implemented.	Same as Alternative 1 for the M-Pit.	An operational verification program would be implemented to verify estimates of M-Pit lake water quality and seepage from the tailings storage facility made in this EIS. The operational verification program would include quarterly measurement of flow from the tailings storage facility combined drains and flow into the mine pit. Flow and water quality data would be compared to model predictions presented in this EIS to verify model results and screen for field conditions that vary from model predictions by more than 10 percent. The models would be calibrated using operational data. The calibrated models would be rerun, and, if necessary, pit water or tailings storage facility leachate would be managed or treated, as appropriate.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	General Impact		
	Alternative 1 - No Action Alternative (L-Pit)	Alternative 2 - Proposed Action Alternative (M-Pit)	Alternative 3 - Agency Modified Alternative
Surface Water	The Clancy Creek channel would not be disturbed and the current flow regime in Clancy Creek would not be altered.	Approximately 1,800 feet of Clancy Creek channel northwest of the M-Pit would be excavated and removed. Clancy Creek would be conveyed in a combined 2,000-foot pipe and 600-foot lined channel near the mine pit.	Similar to Alternative 2, except that Clancy Creek would be routed to a constructed open-flow channel around the northwest side of the mine pit soon after commencing the M-Pit Mine Expansion. This constructed channel would be designed to mimic the existing stream channel.
	During operations, 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow would be appropriated from Clancy Creek at a point of diversion downstream of Kady Gulch. Up to 1,000 gpm (2.2 cfs) would be appropriated from Spring Creek.	Same as Alternative 1.	Same as Alternative 1.
	The Pen Yan Creek channel has been permitted for diversion but would not be disturbed in the L-Pit plan.	Approximately 3,800 feet of the existing ephemeral Pen Yan Creek channel would be covered with waste rock and the channel would be realigned.	Same as Alternative 2.
	After mining ceases, flows from Clancy Creek would not be used to fill the L-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would be used to fill the M-Pit to accelerate pit lake filling.	After mining ceases, flows from Clancy Creek would not be used to fill the M-Pit to accelerate pit lake filling.
	The concentration of sulfate in Spring Creek would temporarily increase.	The concentration of sulfate in Spring Creek would temporarily increase more than Alternative 1.	Same as Alternative 2.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Wetlands	There are no direct impacts to wetlands.	Mining would impact 2.63 acres of wetlands. An additional 2.13 acres of existing scrub/shrub and emergent wetlands would be disturbed in the proposed mitigation site to achieve designed mitigation. The total wetland disturbance is 4.77 acres. The total proposed migration is 5.13 acres. The proposed wetlands mitigation plan would create 3.0 acres of new wetlands to replace the 2.63 acres of wetlands impacted by the M-Pit Mine Expansion for an average replacement ratio of 1.14 to 1.	Similar to Alternative 2, except there is potential for some additional wetlands to reestablish along the constructed open-flow channel for Clancy Creek.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Wildlife	Effects resulting from altered habitats (L-Pit, waste rock storage areas, tailings storage facility), including reclaimed sites, would persist. Mining has destroyed pre-mining wildlife habitat. Some animals seem to have habituated to mine-related activity. The quality of wildlife cover in reclaimed lands has been lowered due to reduced amounts of shrubs and conifers. Some animals, however, may benefit from the increased acreage of grassland foraging habitat.	Similar to Alternative 1, except additional impacts would be additive to those that have already occurred. Impacts primarily would be additional loss of wildlife habitat mostly through expansion of the mine pit and waste rock storage areas and redisturbance of reclaimed waste rock storage acres.	Same as Alternative 2, except that limiting motorized travel in important winter and summer ranges would be beneficial to deer and elk; and donating the mill, warehouse, office buildings, laboratory, and two outside storage buildings to the Jefferson Local Development Corporation but with the requirement of using only existing building sites and reclaiming other areas would result in less impact to wildlife.
	Total area disturbed is 1,199.5 acres.	Total area disturbed is 1,452.2 acres.	Total area disturbed is 1,489.1 acres.
Fisheries and Aquatics	Short-term impact to aquatic habitat associated with appropriation of 50 gpm (0.11 cfs) to 250 gpm (0.56 cfs) of flow in Clancy Creek at a point of diversion downstream of Kady Gulch. No long-term impacts to fisheries and aquatic resources.	Same as Alternative 1.	Same as Alternative 1.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Fisheries and Aquatics (Cont.)	The Clancy Creek stream channel would not be impacted.	Approximately 1,800 feet of Clancy Creek channel and associated aquatic habitat northwest of the M-Pit would be excavated and removed. The channel would be replaced with a combination 2,000-foot-long, 16-inch-diameter pipe and 600-foot lined channel. There would be loss of connection with stream habitat in Clancy Creek upstream of the mine pit diversion.	Clancy Creek would be routed to a constructed open-flow channel soon after commencing the M-Pit Mine Expansion and habitat would remain connected. The restored channel area would be fenced to discourage livestock grazing and other human caused channel disturbances in order to preserve habitat in the long-term. The Montana Tunnels diversion structure on Clancy Creek would be enhanced to ensure it remains a barrier to fish migration in the future.
	No loss of habitat; the flow regime in Clancy Creek channel would not altered.	A portion of Clancy Creek would be diverted into the M-Pit. There would be the loss of available habitat during and after mine operations from an altered flow regime in Clancy Creek.	Only flood events greater than the 1 in 20 year return period 24 hour storm event would be diverted to the M-Pit. No loss of habitat in Clancy Creek is anticipated.
Socioeconomics	Loss of approximately 180 full time jobs and 35 part time jobs in 2009.	Economic benefits of the mine extended 4.5 years to 2013.	Same as Alternative 2.
	Loss of about $2.5 million in annual wage income above county average wages in 2009. Loss of secondary benefits to local businesses in 2009.	Loss of jobs, income and secondary benefits mentioned in Alternative 1 would occur in 2013 rather than 2009.	Same as Alternative 2.

TABLE A-2 Summary of Impacts from All Alternatives			
Resource, Land Use, or Activity	**General Impact**		
	Alternative 1 - No Action Alternative (L-Pit)	**Alternative 2 - Proposed Action Alternative (M-Pit)**	**Alternative 3 - Agency Modified Alternative**
Socioeconomics (Cont.)	In 2009, loss of mine-generated tax revenue.	About $9.5 million more in taxes revenues would be generated through 2013 compared to Alternative 1.	Same as Alternative 2.
	Additional metals would not be extracted from the mine after 2009.	Additional metals would be extracted from the mine until 2013.	Same as Alternative 2.
	Road maintenance and recreation costs would end in 2009.	Road maintenance and recreation costs would be slightly higher than under Alternative 1.	Same as Alternative 2.
Cultural Resources	Eight previously documented historical mining sites have already been recorded and mitigated through photographic documentation.	No formal consensus determination of eligibility for five properties potentially "eligible" for listing located within the proposed permit expansion area.	Same as Alternative 2, except photographic documentation would be required of any historic sites to be impacted by the M-Pit Mine Expansion. The photographs would be deposited in a local library and the State Historic Preservation Office.

Notes:
Cont. = Continued

TABLE A-3 **Common Species Occurring In Wetlands**			
Species	**Vegetation Type**		
	Emergent	**Scrub-shrub**	**Forested**
Grass/grass-like:			
Agrostis stolonifera (A. alba)		WR	A
Calamagrostis canadensis		WR	WR
Carex microptera	C	WR	C
Carex nebraskensis	WR		
Carex rostrata (utriculata)		WR	
Glyceria striata		C	C
Juncus balticus	WR		
Phleum pratense	WR	WR	WR
Poa palustris		WR	C
Poa pratensis	A	WR	A
Forbs:			
Achillea millefolium	WR		C
Angelica arguta		C	C
Aster foliaceus	C	C	WR
Aster modestus		WR	C
Epilobium ciliatum		C	
Equisetum arvense		C	WR
Geum macrophyllum	WR	WR	C
Heracleum lanatum		WR	C
Mentha arvensis		WR	C
Potentilla gracilis	WR		
Senecio triangularis		C	WR
Thalictrum occidentale			WR
Shrubs:			
Alnus incana		WR	A
Cornus stolonifera		WR	C
Ribes inerme		C	WR
Ribes lacustre			WR
Ribes setosum		WR	
Rosa acicularis			WR
Rosa woodsii		C	WR
Rubus idaeus		WR	WR
Salix bebbiana	C	WR	WR
Salix boothii	C	A	WR
Salix drummondiana		A	
Trees:			
Picea engelmannii			WR
Populus tremuloides			A
Pseudotsuga menziesii			A

Notes:

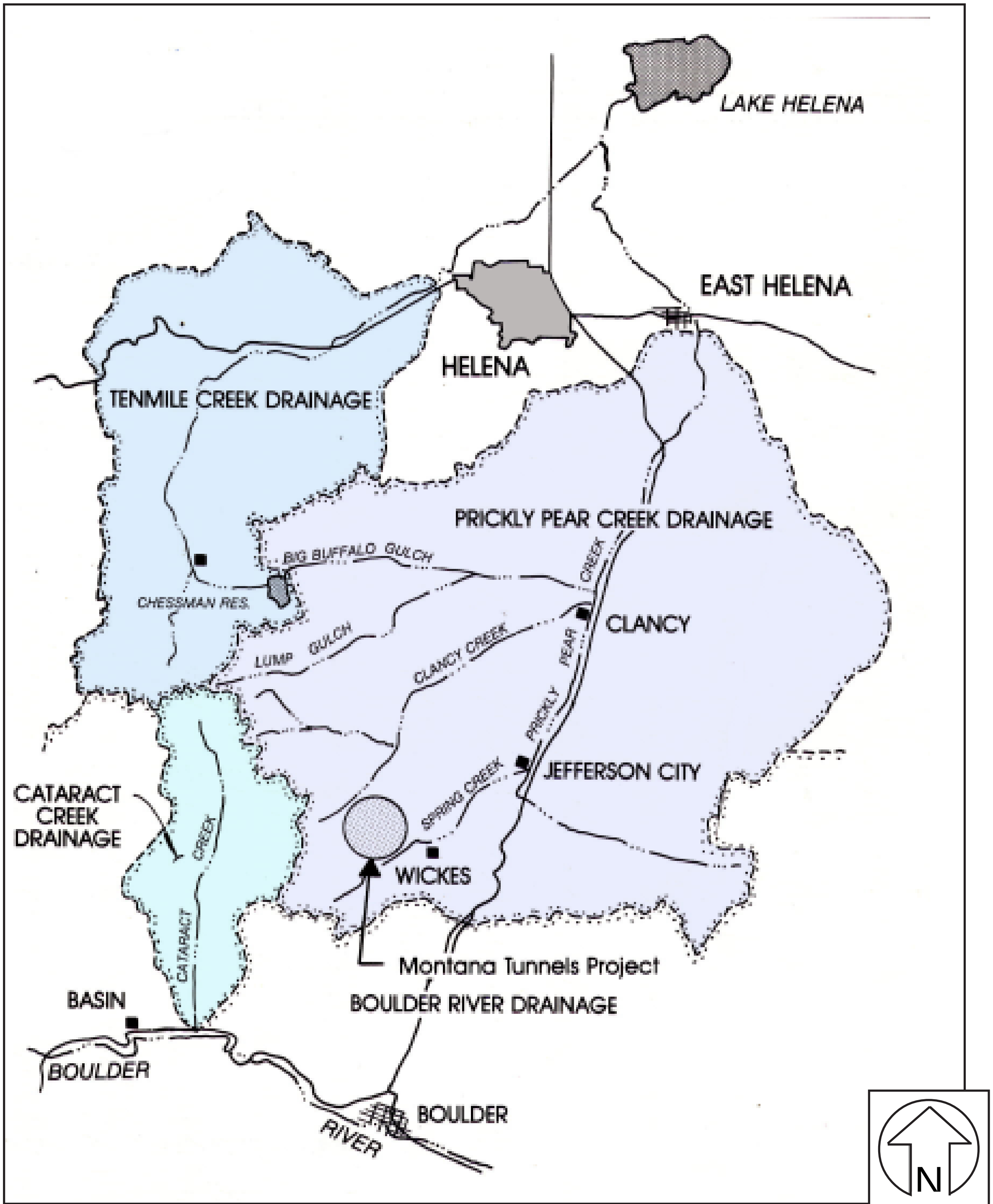
C common: less than 1 percent canopy cover
WR well represented: less than 5 percent canopy cover
A abundant: less than 25 percent canopy cover

Plant Nomenclature from Booth and Wright (1966)

TABLE A-4 **Wetland Disturbance Acreage And Proposed Mitigations**				
Wetland Vegetation Type	**Wetland Disturbance Area (acres)**	**Percent**	**Proposed Mitigation Ratio**	**Proposed Mitigation Area (acres)**
Mine Pit Expansion Area				
Emergent	0.22	9	1:1	0.22
Scrub-shrub	1.70	64	1:1	1.70
Forest	0.72	27	1.5:1	1.08
Total	2.64	100	1.14:1	3.00
Mitigation Area				
Emergent	0.50	23	1:1	0.50
Scrub-shrub	1.63	77	1:1	1.63
Total	2.13	100	1:1	2.13
TOTAL	**4.77**			**5.13**

TABLE A-5 Species to be Included in Revegetation Mixes		
Trees	**Shrubs**	**Herbaceous species**
Quaking aspen	Thinleaf alder	Nebraska sedge
Engelmann Spruce	Red-osier dogwood	Baltic rush
Black cottonwood	Bebb willow	Redtop
	Booth willow	Bluejoint reedgrass
	Drummond willow	Beaked sedge
	Raspberry	Mannagrass

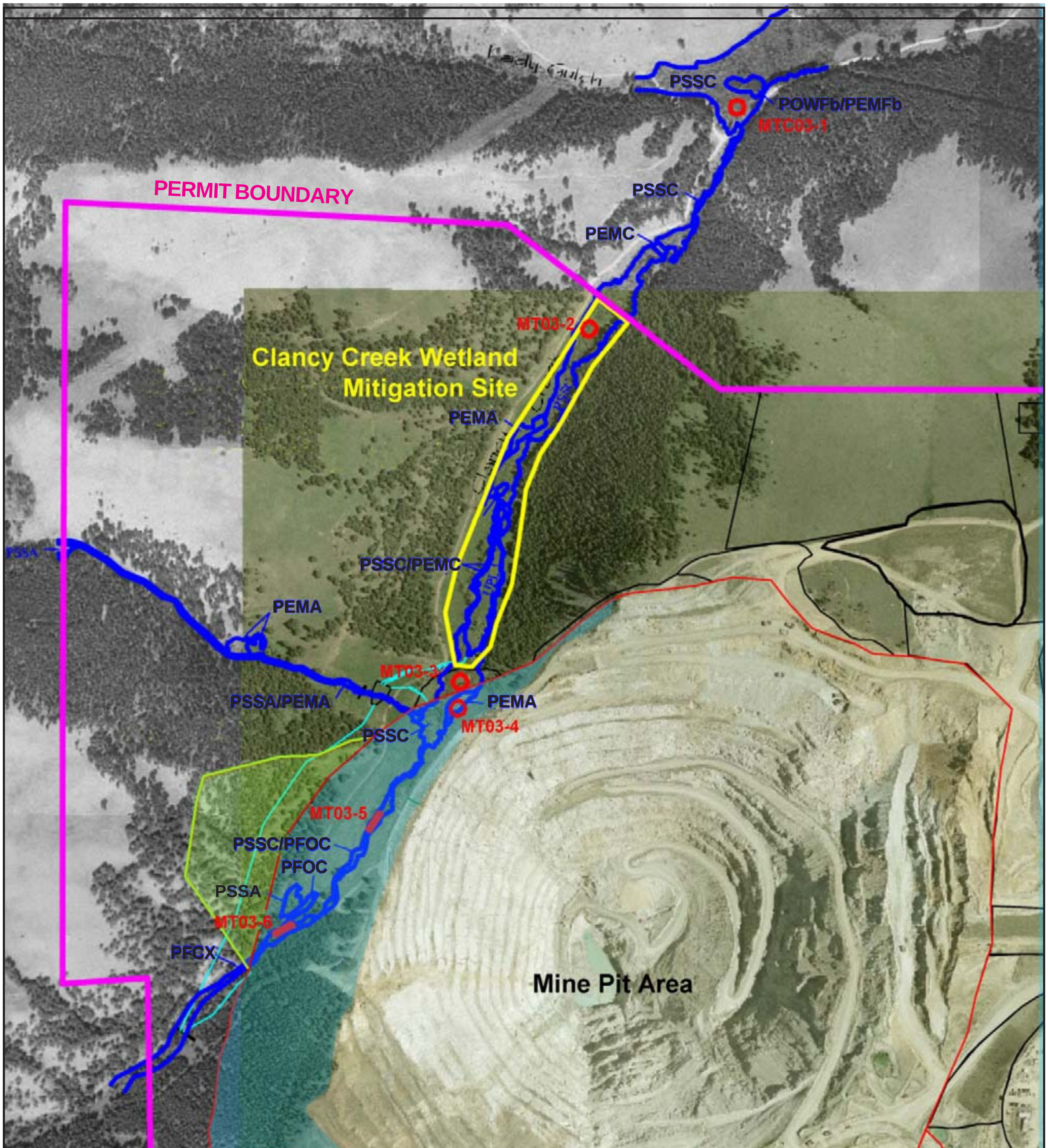
FIGURES



SCALE 1" = 10 miles (approximately)

FIGURE A-1
Project Location and Study Area

Montana Tunnels Project



PERMIT BOUNDARY
WETLAND PLOT
WETLAND BOUNDARY
CLANCY CREEK WETLAND MITIGATION SITE
M-PIT PROPOSED OPEN PIT OUTLINE
CLANCY CREEK DIVERSION
(16-INCH DIAMETER PIPE)
AREA OF PROPOSED M-PIT EXPANSION
AREA OF LAYBACK

WETLANDS LEGEND

WETLAND CLASSIFICATION

POW	Palustrine Open Water
PEM	Palustrine Emergent
PFC	Palustrine Forested
PSS	Palustrine Scrub-Shrub

WATER REGIME

A	Temporarily Flooded
C	Seasonally Flooded
D	Seasonally Flooded/Well Drained
F	Semi-Permantly Flooded
H	Permant
Y	Saturated/Semi-Permant/Seasonal

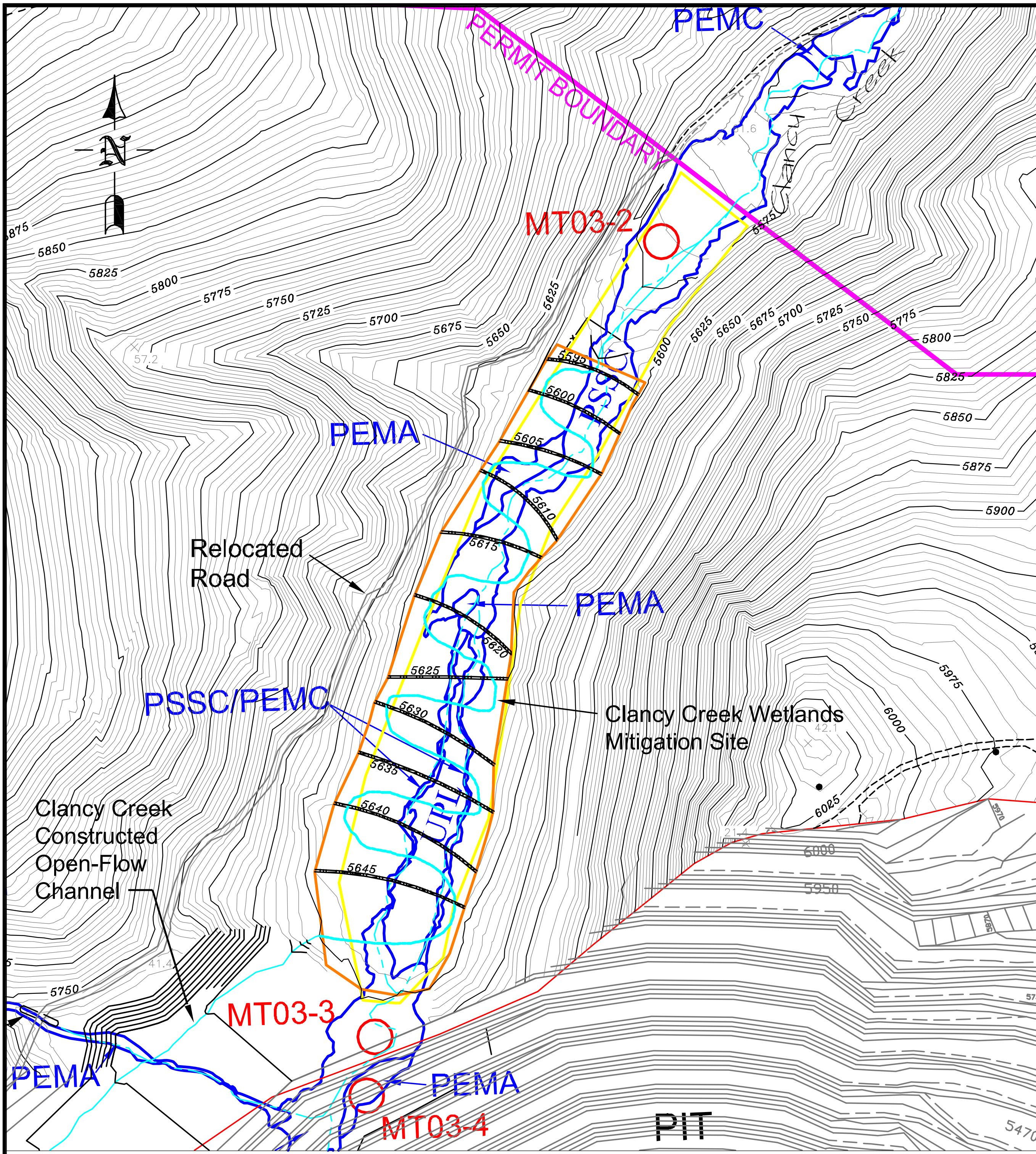
SPECIAL MODIFIERS

b	Beaver
d	Partially Drained/Ditched
h	Diked/Impounded
s	Spoil

FIGURE A-2
Proposed Action Alternative (M-Pit)
Mine Pit Expansion and Clancy Creek
Disturbance

SOURCE: Montana Tunnels 2007

Montana Tunnels Project



WETLAND LEGEND

	PERMIT BOUNDARY
	WETLAND PLOT
	EXISTING WETLAND BOUNDARY
	PROPOSED WETLAND MITIGATION SITE
	ORIGINAL WETLAND MITIGATION SITE (2005)

WETLAND CLASSIFICATION	
POW	PALUSTRINE OPEN WATER
PEM	PALUSTRINE EMERGENT
PFO	PALUSTRINE FORESTED
PSS	PALUSTRINE SCRUB-SHRUB
UPL	UPLAND
R3UB1	RIVERINE UPPER PERENNIAL UNCONSOLIDATED BOTTOM COBBLE/GRAVEL

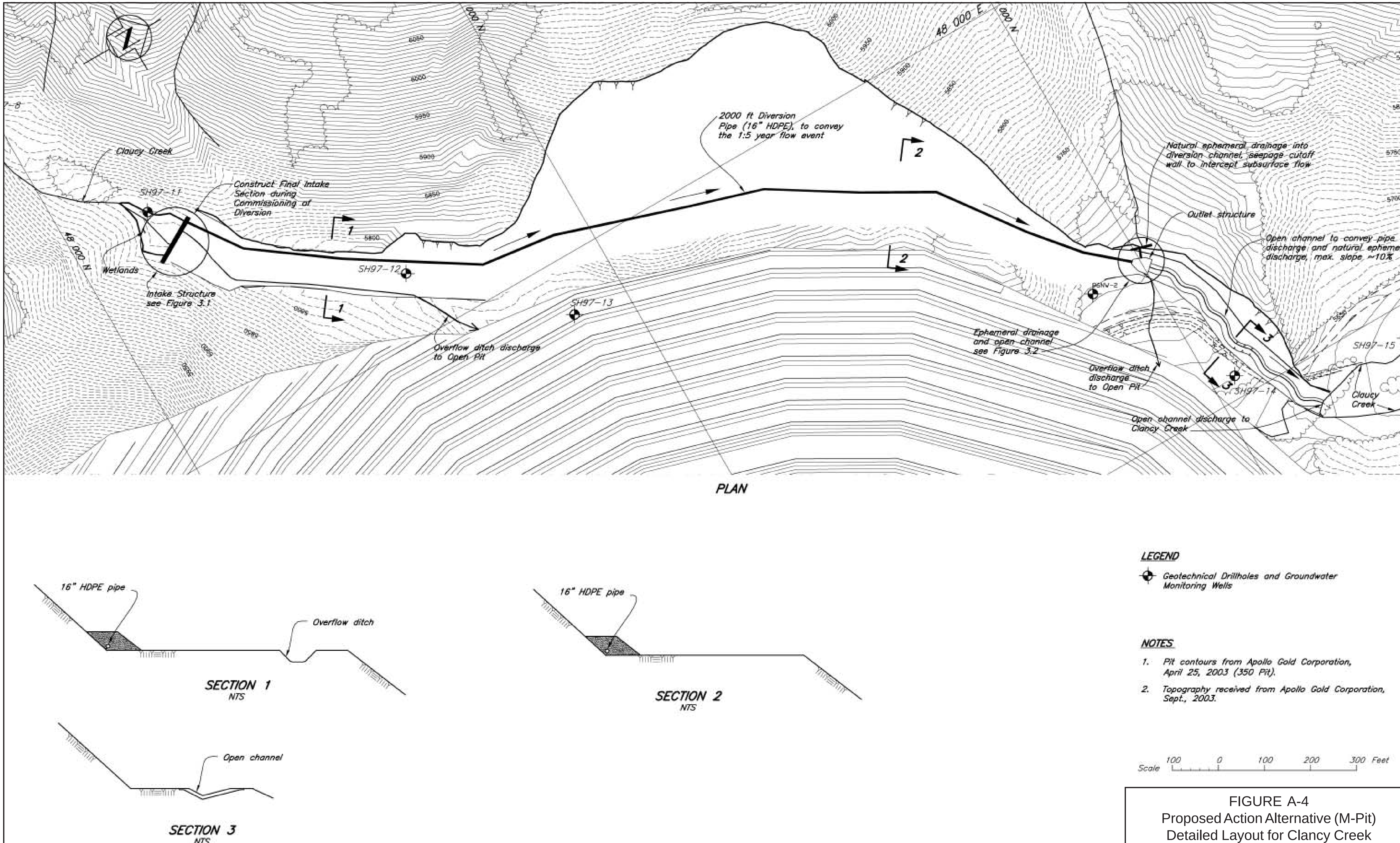
WATER REGIME	
A	TEMPORARILY FLOODED
C	SEASONALLY FLOODED
D	SEASONALLY FLOODED/WELL DRAINED
F	SEMIPERMANENTLY FLOODED
H	PERMANENT
Y	SATURATED/SEMIPERMANENT/SEASONAL

SPECIAL MODIFIERS	
b	BEAVER
d	PARTIALLY DRAINED/DITCHED
h	DIKED/IMPOUNDED
s	SPOIL

NOTE: Surface Configuration for Alternative 3 - Agency Modified Alternative is shown.

FIGURE A-3
Clancy Creek Wetlands Mitigation Area

Montana Tunnels Project



LEGEND

Geotechnical Drillholes and Groundwater Monitoring Wells

NOTES

1. Pit contours from Apollo Gold Corporation, April 25, 2003 (350 Pit).
2. Topography received from Apollo Gold Corporation, Sept., 2003.

Scale 100 0 100 200 300 Feet

SOURCE: Montana Tunnels 2007

FIGURE A-4
Proposed Action Alternative (M-Pit)
Detailed Layout for Clancy Creek Diversion
Montana Tunnels Project

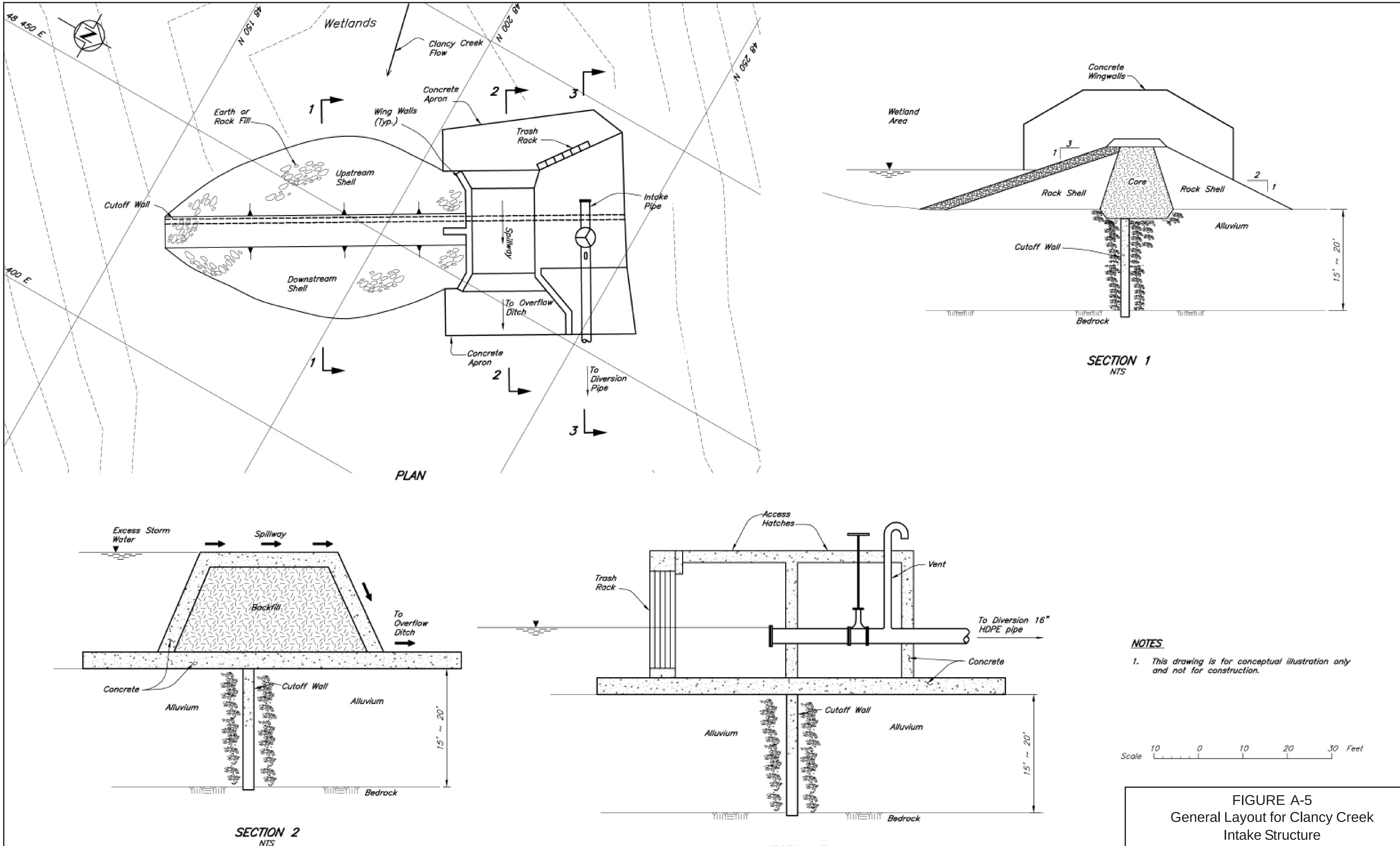
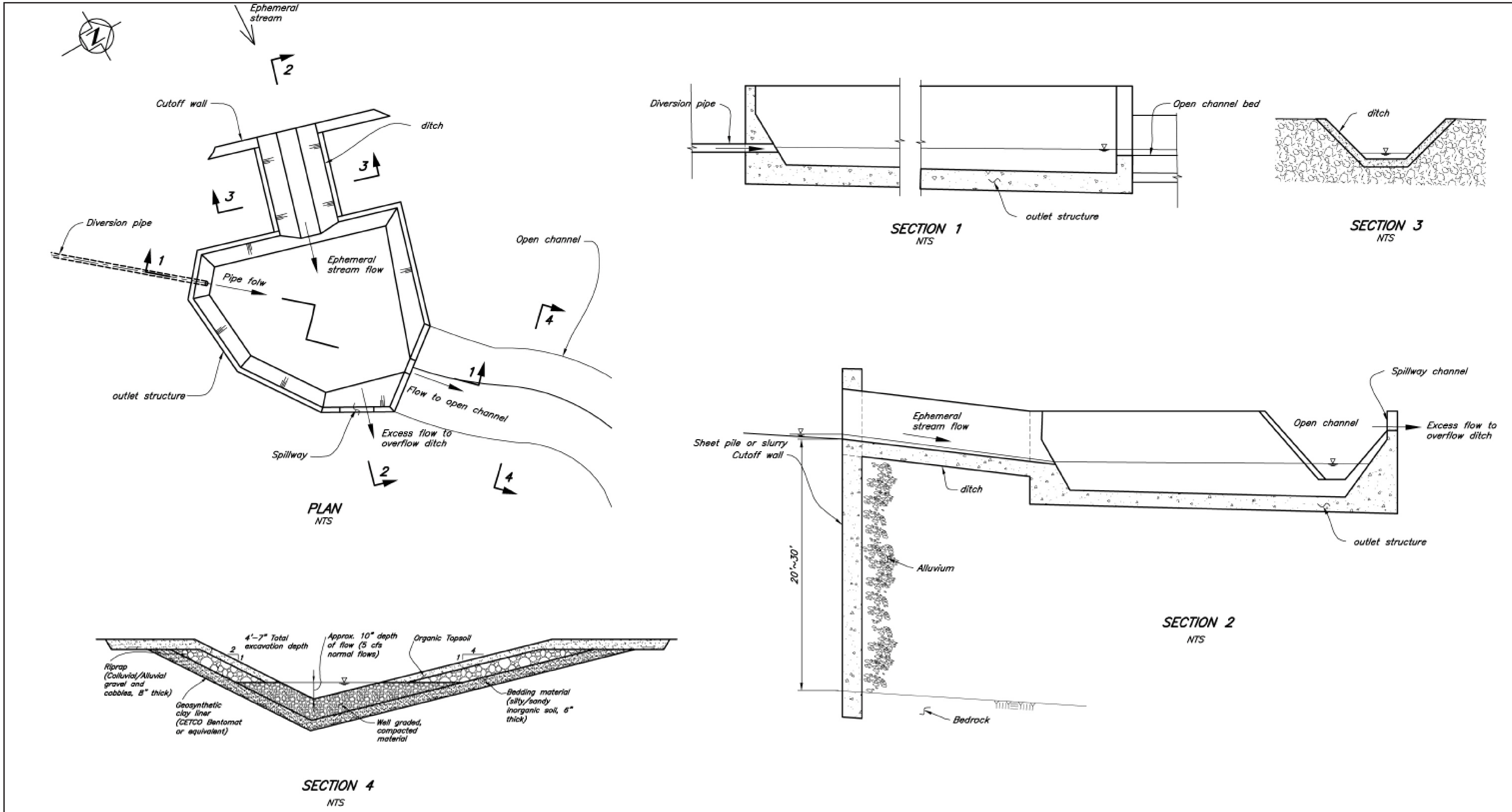


FIGURE A-5
General Layout for Clancy Creek Intake Structure

Montana Tunnels Project

SOURCE: Montana Tunnels 2007



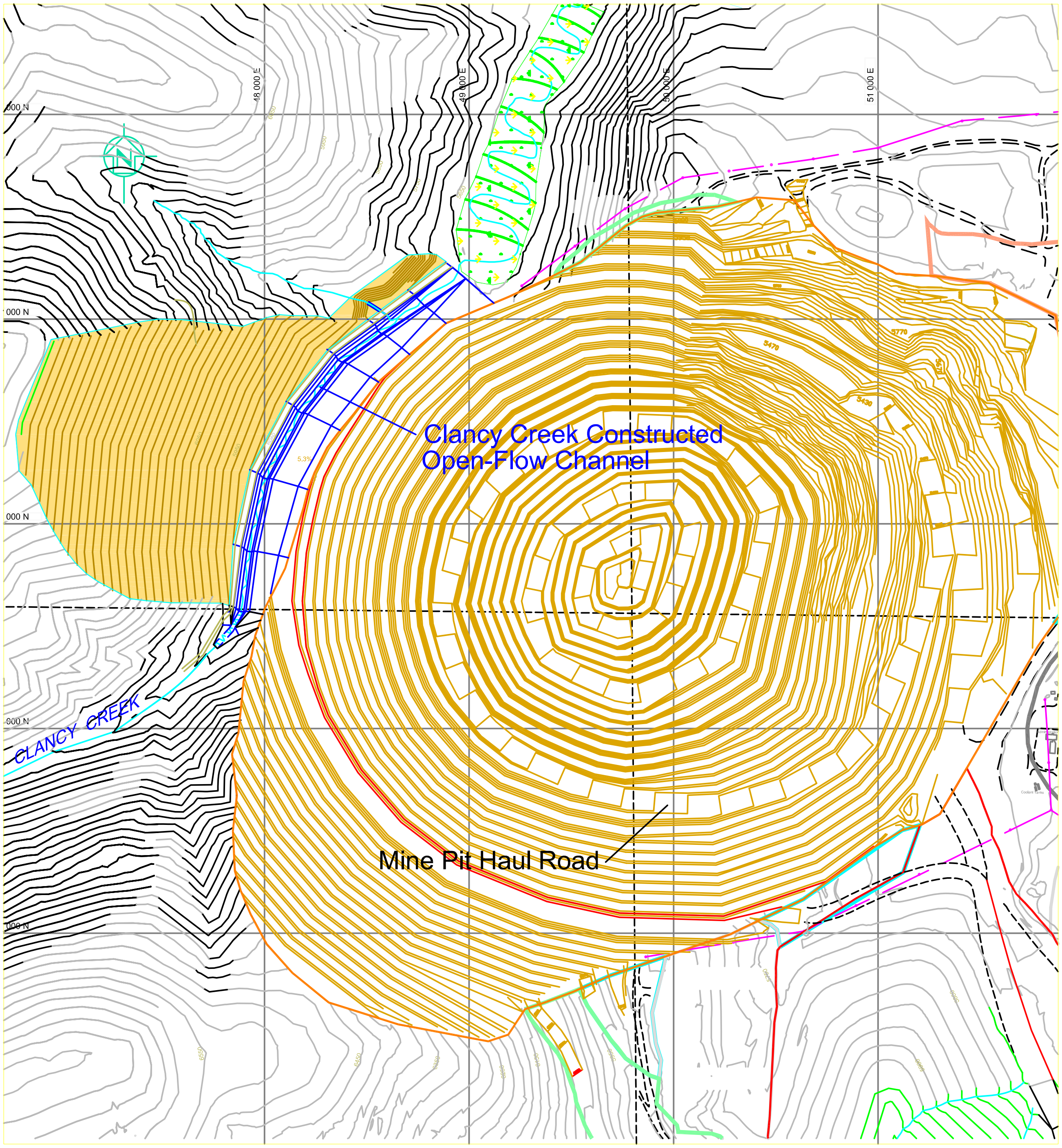
NOTES

1. This drawing is for conceptual illustration only and not for construction.
2. Alternatively, instead of concrete structures, the cutoff wall, ditch and outlet structure can be constructed by using Bentonite/geosynthetic clay liner with riprap protection, similar to those shown in SECTION 4.

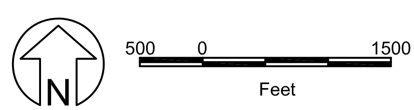
SOURCE: Montana Tunnels 2007

FIGURE A-6
General Layout for Ephemeral Drainage and Open Channel

Montana Tunnels Project



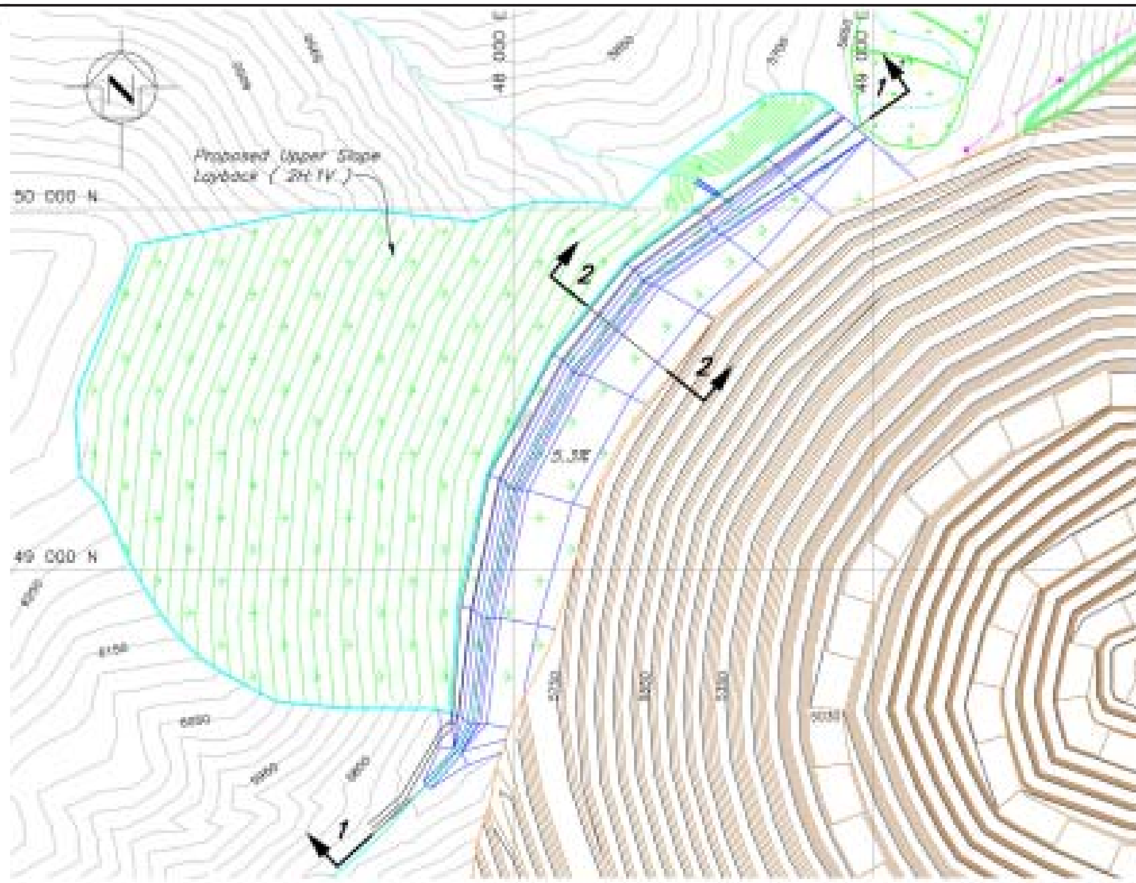
Source: Apollo Gold, Inc.



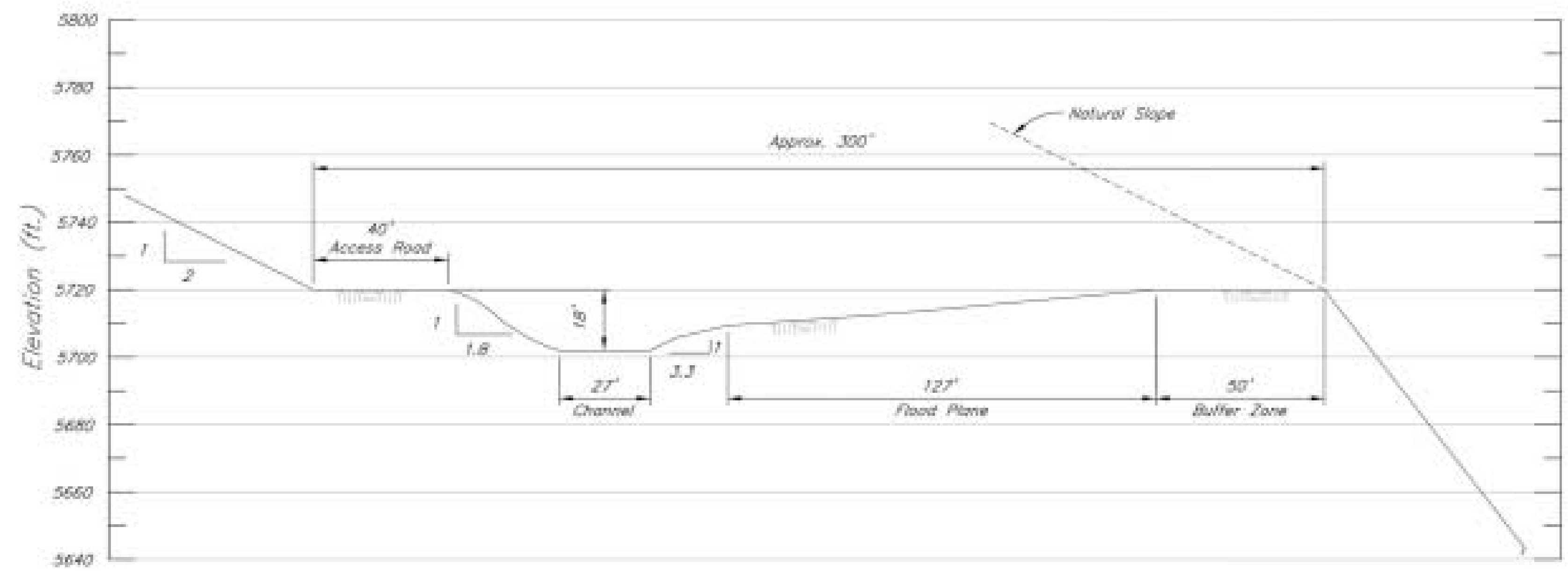
Layback
Exisitng Clancy Creek Channel
Clancy Creek Constructed Open-Flow Channel
Clancy Creek Wetlands Mitigation Site

FIGURE A-7
Agency Modified Alternative
Clancy Creek Diversion and Final
Channel Location

Montana Tunnels Project



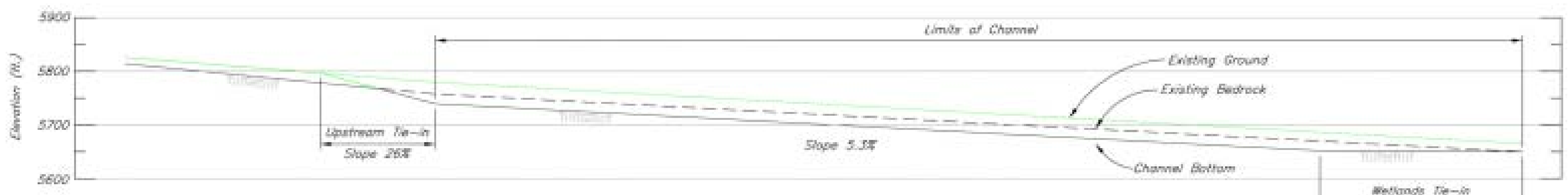
DIVERSION CHANNEL PLAN
Scale A



SECTION 2
Scale C

NOTE:

1. Pit plan provided by MTMI (July 2007).



SECTION 1
Scale B

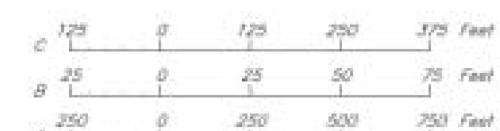


FIGURE A-8
Agency Modified Alternative
Clancy Creek Diversion Channel Design
Conceptual Plan and Sections

Montana Tunnels Project

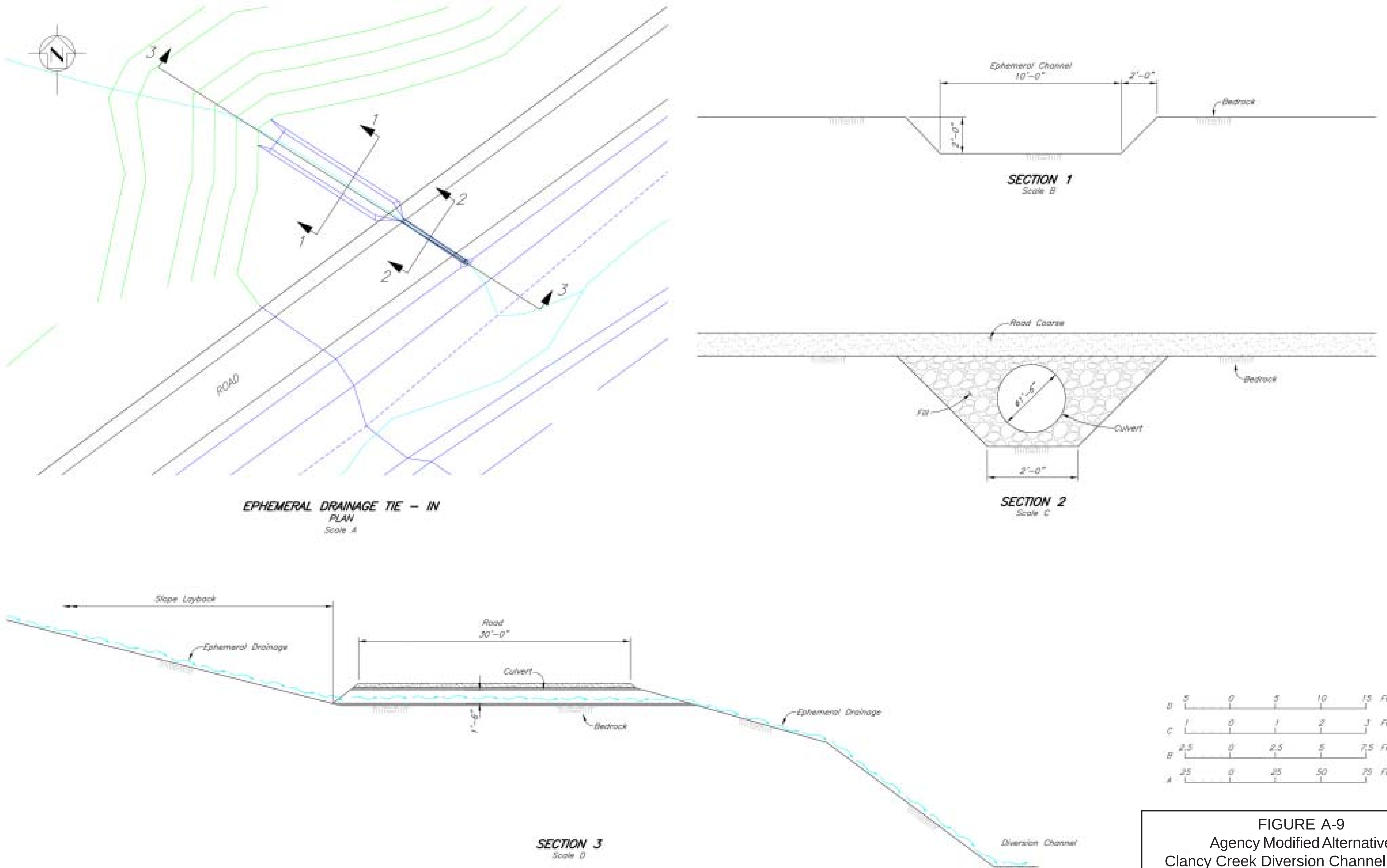
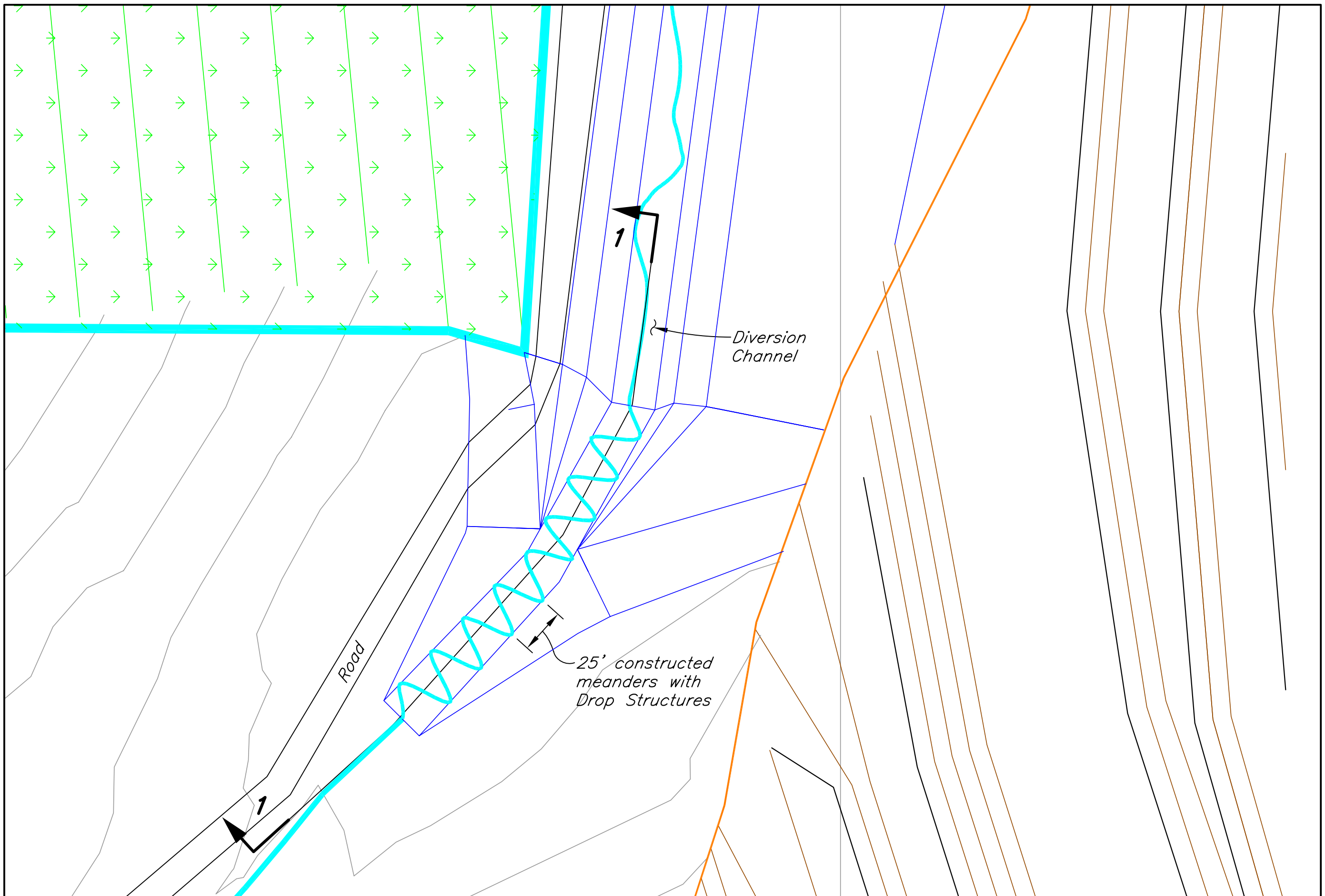
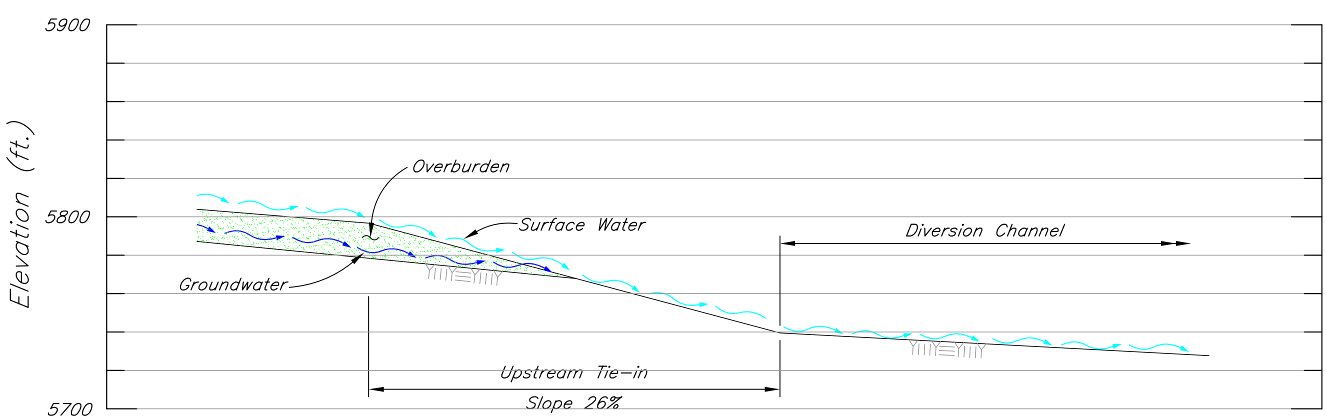


FIGURE A-9
Agency Modified Alternative
Clancy Creek Diversion Channel Design
Ephemeral Drainage Tie-In
Conceptual Plan and Sections

Montana Tunnels Project



UPSTREAM CHANNEL TIE – IN
PLAN



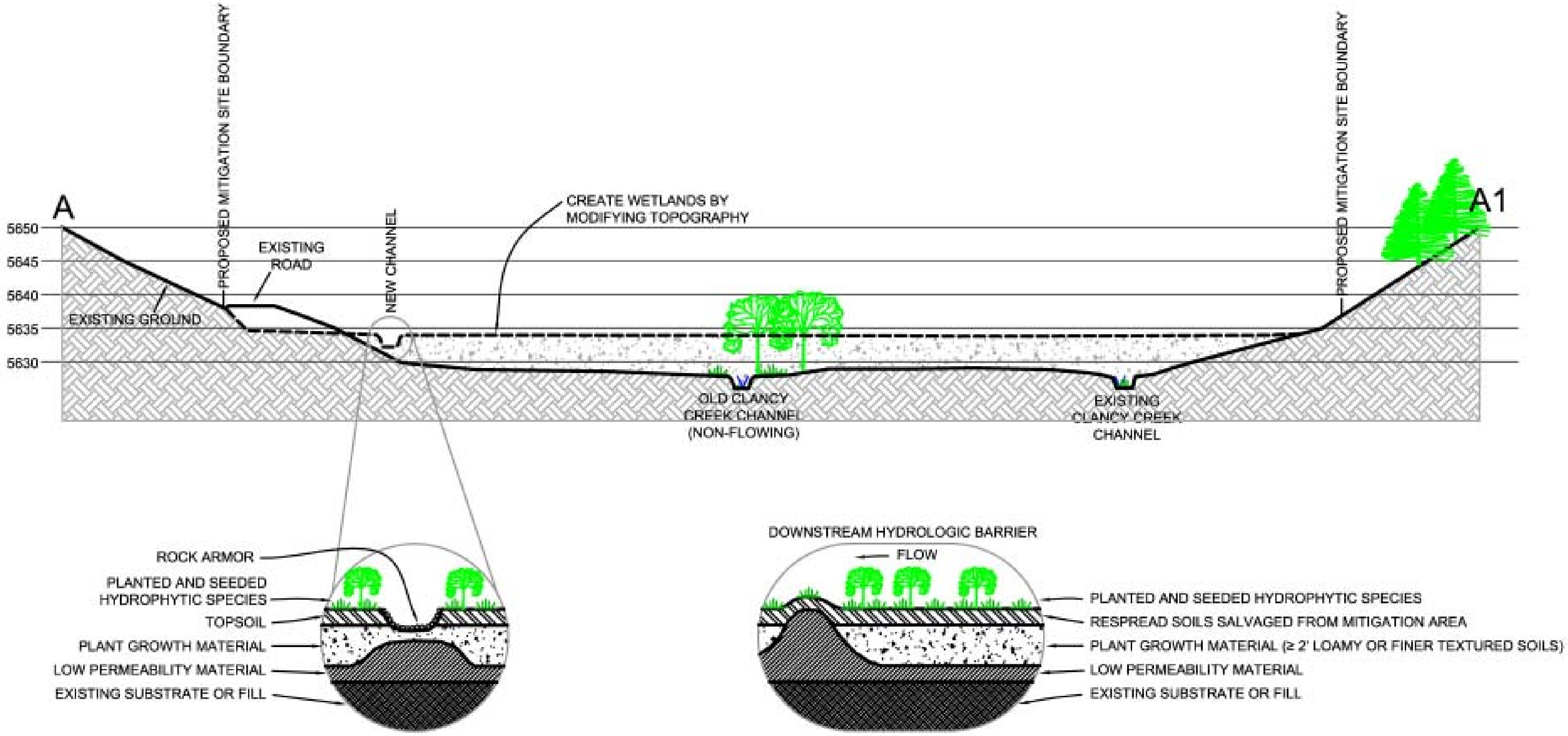
SECTION 1

NOTE:

1. Area of upstream tie–in is 25,300 sq. ft.

Scale 50 0 50 100 150 Feet

FIGURE A-10
Agency Modified Alternative - Clancy Creek Diversion Channel Design Upstream Channel Tie-In Conceptual Plan And Section
Montana Tunnels Project



VERTICAL SCALE: 1"=25'
HORIZONTAL SCALE: 1"=50'

FIGURE A-11
Agency Modified Alternative
Cross Section for Clancy Creek
Wetlands Mitigation Area

Montana Tunnels Project

SOURCE: Montana Tunnels 2007

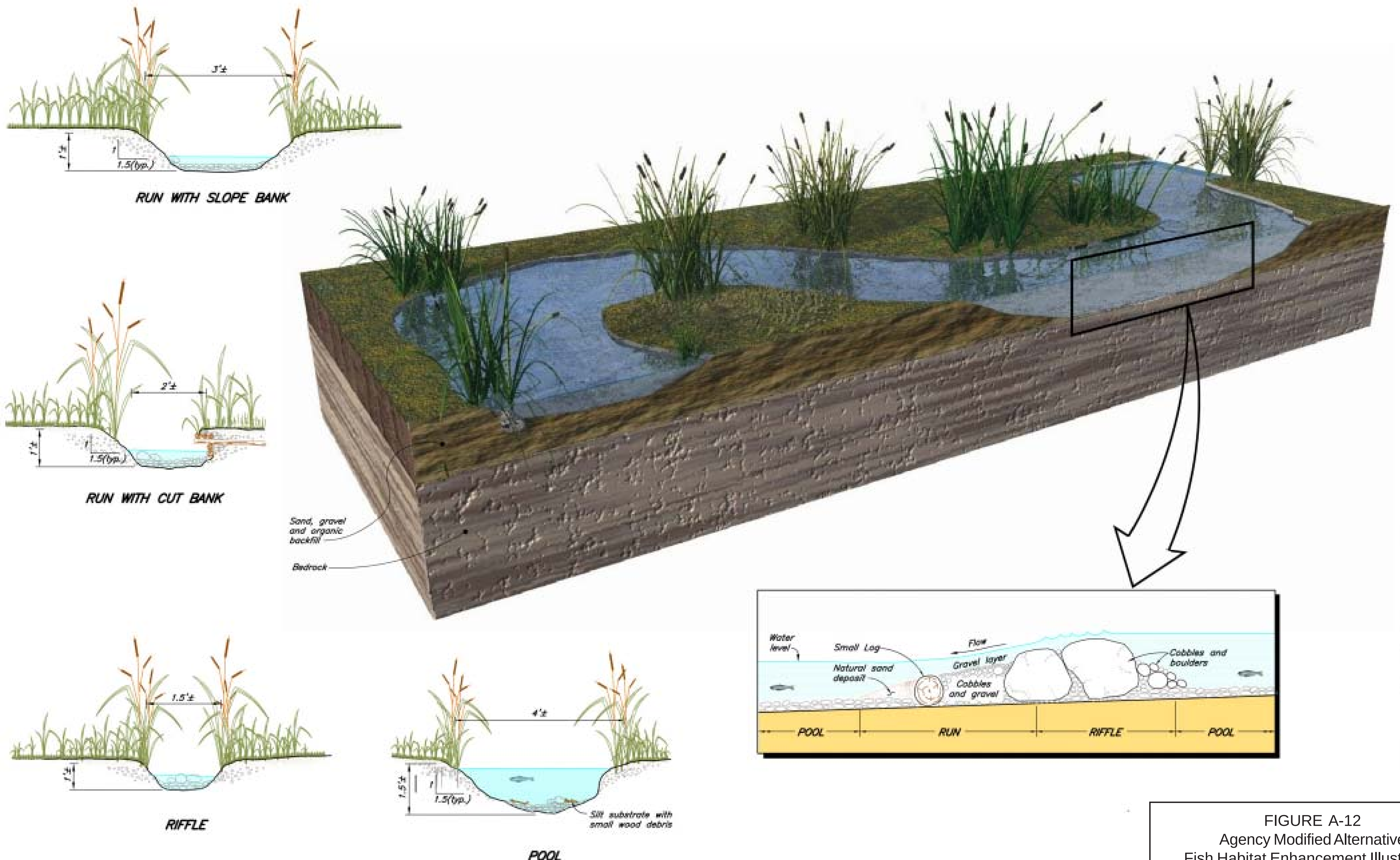


FIGURE A-12
Agency Modified Alternative
Fish Habitat Enhancement Illustration

Montana Tunnels Project

ATTACHMENT A-1

Inspection Letter

August 26, 2005

REPLY TO
ATTENTION OF

Helena Regulatory Office
Phone: (406) 441-1375
Fax: (406) 441-1380

RE: Corps File No. 2004-90-786, Montana Tunnels Mine Expansion

Mr. John Schaefer
Montana Tunnels Mining, Inc.
PO Box 176
Jefferson City, Montana 59638

Dear Mr. Schaefer:

This letter is a followup to the on site inspection conducted on June 21, 2005, to verify the wetland delineation conducted by Westech, and view the potential compensatory mitigation areas for the proposed Montana Tunnels Mine Expansion near Jefferson City, Montana.

The site visit was attended by Dean Culwell (Westech), you and Pierre Lemieux (Montana Tunnels), and myself. The wetland boundaries delineated by Westech were determined to be accurate, with the exception of an area just downstream from sample plot MT03-6. A wedge shaped wetland identified as PSSA and a rectangular PFOC were determined to be non-wetland, because after digging two soil pits about 18 inches deep, there was no free water in the pits, and the soil was only very slightly damp. There had been more precipitation than in the previous several years at the time of the inspection, and one would expect a wetter substrate, however, there were no hydrologic indictors at this location. There was a thick (>18 inches) layer of low chroma organic soil and we determined that the area had probably been influenced by beaver activity in the past. When the area was homesteaded, the beaver dams were removed resulting in draining of much of the pre-existing wetlands. The absence of any hydrologic indicators at this site, renders the two delineated polygons non-wetlands. See the enclosed excerpt from the delineation map.

The remaining wetlands and the Clancy Creek channel are determined to be jurisdictional pursuant to Section 404 of the Clean Water Act. After revisiting the Pen Yan Creek site, and after learning that the ultimate destination of Pen Yan's flow is the tailings pond where it is re-circulated and used in the milling process, the Corps has determined that Pen Yan Creek is not jurisdictional. If you disagree with these jurisdictional determinations, you have the right to appeal the decision. If you would like more information on the jurisdictional appeal process, contact this office.

During the June 21 site visit, we also looked at the proposed mitigation sites to get a preliminary idea of their appropriateness for replacing the impacted resources on Clancy Creek. You indicated a preference for the lower Spring Creek site for mitigation. It is doubtful that the

impacts to the forested portions of Clancy Creek could be replaced at this location within a reasonable timeframe. There would be considerable time lag between the impacts on Clancy Creek and the development of a forested overstory on lower Spring Creek. I agree that the potential to develop herbaceous and scrub-shrub wetland is good there, but we must examine other options that would recreate or restore portions of Clancy Creek that are forested. During our site visit, we identified a segment of Clancy Creek, within the proposed mitigation area, with a forested overstory that had been abandoned by channel relocation, which the Corps will consider a viable mitigation alternative (in combination with the mitigation alternatives described in the April 2005 Westech Plan), unless information is presented that demonstrates otherwise. There are some concerns with the close proximity of the tailings repository, which will have to be addressed as we consider each mitigation proposal.

The upper Spring Creek site is a channelized portion of perennial stream that has good stream mitigation potential. Much of the floodplain here appears to already be wetland, so wetland development potential may not produce much as far as wetland acres created.

The Clancy Creek site has fair potential for wetland creation, and does have an opportunity to re-establish a segment of abandoned forested stream channel.

The two Pen Yan sites are not suitable for wetland or stream mitigation because of the steep slopes on the upper reach, the unjustified loss of high quality upland habitat, and the poor water quality from the Washington mine drainage.

Based on my current understanding of the proposed action, the Montana Tunnels Expansion will require an Individual Permit. Nationwide 44 for mining activities does not allow impacts to perennial streams associated with hard rock or mineral mining. Compensatory mitigation for the unavoidable impacts to wetlands and Waters of the U.S. will be required at the ratios described in the enclosure. When preparing the application, you may refer to the appropriate sections in the draft Environmental Impact Statement (EIS) where the proposed action will be described. Our public notice will coincide with the state’s public comment period. Our alternatives analysis will be done concurrently with the state’s evaluation, based on the alternatives identified in the EIS.

Based on our previous discussions, the Corps requests that a draft Section 404 (b) (1) evaluation or “showing” be included in the draft EIS describing the alternatives for Clancy Creek, including the alternative that the channel not be placed in a pipe, and that an open diversion channel be constructed to permanently route the creek around the perimeter of the expanded pit. We will need this alternative evaluated to determine if it is a) practicable and b) expected to have fewer adverse impacts than placing the creek in a pipe. The showing is required to solicit public comments on the alternatives that are specific to Section 404 of the Clean Water Act.

Be aware that a certification or waiver from the DEQ pursuant to Section 401 of the Clean Water Act is required prior to finalizing a permit decision. When you submit your Joint Application to us, please provide a copy to Mr. Jeff Ryan with the DEQ. The 401 certification process also runs concurrently with the Corps permit evaluation. Please contact me if you have questions or would like to discuss any of the above.

Sincerely,

Jean Ramer
Project Manager
Helena Regulatory Office
Jean.L.Ramer@usace.army.mil

Enclosures
Excerpt from Wetland Delineation Map
Mitigation Ratios (effective April 2005)

CF: (with enclosures)

Mr. Greg Hallsten
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PO Box 200901
Helena, Montana 59620-0901

Mr. Jeff Ryan
MDEQ
PO Box 200901
Helena, Montana 59620-0901

Ms. Kristine Knutson
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10 West 15th Street, Suite 3200
Helena, Montana 59626

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765 Colleen Street
Helena, Montana 59601

ATTACHMENT A-2

Wetland Functions and Values Assessment

ATTACHMENT A-2

MDT Montana Wetland Assessment Form (revised May 25, 1999)

1. Project Name: Montana Tunnels Mine Expansion **2. Project #:** - **Control #:** -

3. Evaluation Date: Mo. 08 Day 05 Yr. 03 **4. Evaluator(s):** Dean Culwell, Ken Scow, Dan Culwell , Ed Darfler **5 . Wetlands/Site(s)** MT03-3,4,5,and 6 (Clancy Creek and Unnamed Tributary)

6. Wetland Location(s): i. Legal: T 7 N or S; R 4 E or W; S 8 NW 1/4 ; T ____ N or S; R ____ E or W; S ____________________ ;
ii. Approx. Stationing or Mileposts: N/A
iii. Watershed: 07 Missouri-Sun-Smith **GPS Reference No. (if applies):** N/A
Other Location Information: Mt. Tunnels Mine is located ≈ 15 miles south-southwest of Helena in Jefferson County. The wetland is located on the northwestern edge of the MTMI pit.

7. a. **Evaluating Agency:** USACE/MDEQ; **8. Wetland size:** (total acres) - (total visually estimated); 2.9 (direct=2.4, indirect=0.5) acres filled
b. **Purpose of Evaluation:** 8.92 (measured, *e.g.* by GPS [if applies])
1.____Wetlands potentially affected by MDT project
2.____ Mitigation wetlands; pre-construction
3.____ Mitigation wetlands; post-construction
4._X_ Other: Wetlands affected by mine expansion

9. Assessment area: (AA, tot., ac., see instructions on determining AA) - (visually estimated) 8.92 (measured, *e.g.* by GPS [if applies])

10. Classification of Wetland and Aquatic Habitats in AA (HGM according to Brinson, first col.; USFWS according to Cowardin [1979], remaining cols.)

HGM Class	System	Subsystem	Class	Water Regime	Modifier	% of AA (% of WL)
Riverine (Upper Perennial)	Palustrine		EM	A		8
	Palustrine		EM	C		<1
	Palustrine		SS	A		3
	Palustrine		SS	C		59
	Palustrine		FO	C		13
	Palustrine		SS/FO	C		4
	Palustrine		SS/EM	A		8
	Palustrine		SS/EM	C		5

(Abbreviations: **System**: Palustrine(**P**)/ **Subsyst**.: none/ **Classes**: Rock Bottom (**RB**), Unconsolidated bottom (**UB**), Aquatic Bed (**AB**), Unconsolidated Shore (**US**), Moss-lichen Wetland (**ML**), Emergent Wetland (**EM**), Scrub-Shrub Wetland (**SS**), Forested Wetland (**FO**)/ **System:** Lacustrine (**L**)/, **Subsyst.:** Limnetic (**2**)/ **Classes:** RB, UB, AB/ **Subsystem:** Littoral (**4**)/ **Classes:** RB, UB, AB, US, EM/ **System:** Riverine (**R**)/ **Subsyst.:** Lower Perennial (**2**)/ Classes: RB, UB, AB, US, EM/ **Subsystem:** Upper Perennial (**3**)/ Classes: RB, UB, AB, US/ **Water Regimes:** Permanently Flooded (**H**), Intermittently Exposed (**G**), Semipermanently Flooded (**F**), Seasonally Flooded (**C**), Saturated (**B**), Temporarily Flooded (**A**), Intermittently Flooded (**J**) **Modifiers:** Excavated (**E**), Impounded (**I**), Diked (**D**), Partly Drained (**PD**), Farmed (**F**), Artificial (**A**) **HGM Classes:** Riverine, Depressional, Slope, Mineral Soil Flats, Organic Soil Flats, Lacustrine Fringe

11. Estimated relative abundance: (of similarly classified sites within the same Major Montana Watershed Basin, see definitions)
(Circle one) Unknown Rare **Common** Abundant
Comments: Three of the four community types present in the AA are rated as minor in the region by Hansen *et al.*(1995). The Drummond willow/beaked sedge community type is rated as incidental (rarely occurring in the wetland/riparian zone) and occupies around half of the total AA acreage.

12. **General condition of AA:**

i. Regarding disturbance: (use matrix below to determine [circle] appropriate response)

Conditions within AA	Predominant conditions adjacent to (within 500 feet of) AA		
	Land managed in predominantly natural state; is not grazed, hayed, logged, or otherwise converted; does not contain roads or buildings.	Land not cultivated, but moderately grazed or hayed or selectively logged; or has been subject to minor clearing; contains few roads or buildings.	Land cultivated or heavily grazed or logged; subject to substantial fill placement, grading, clearing, or hydrological alteration; high road or building density.
AA occurs and is managed in predominantly natural state; is not grazed, hayed, logged, or otherwise converted; does not contain roads or occupied buildings.	low disturbance	low disturbance	moderate disturbance
AA not cultivated, but moderately grazed or hayed or selectively logged; or has been subject to relatively minor clearing, fill placement, or hydrological alteration; contains few roads or buildings.	moderate disturbance	moderate disturbance	high disturbance
AA cultivated or heavily grazed or logged; subject to relatively substantial fill placement, grading, clearing, or hydrological alteration; high road or building density.	high disturbance	high disturbance	high disturbance

Comments: (types of disturbance, intensity, season, etc.): Clancy Creek is a perennial stream with good water quality. The majority of the AA and surrounding area have been moderately disturbed by livestock grazing and historic and current mining activities (excavations, roads, clearing, etc.), however, an approximately 1000-foot segment of Clancy Creek in the AA is within 50 to 100 feet of the active Montana Tunnels Mine pit. For this reason, a dual rating of moderate-high disturbance has been selected.

ii. Prominent weedy, alien, & introduced species (including those not domesticated, feral): (list) Introduced perennial grasses (redtop, timothy and Kentucky bluegrass) are abundant in these wetlands. Weedy forbs include Canada thistle, houndstongue, bull thistle and musk thistle.

iii. Provide brief descriptive summary of AA and surrounding land use/habitat: Hydrophytic vegetation is present in a relatively narrow zone along Clancy Creek and its tributary within the AA. Upland forest adjacent to the AA is primarily dominated by Douglas-fir with scattered small stands of quaking aspen on more mesic sites. As described above, a portion of the AA is adjacent to the MTMI pit.

13. **Structural Diversity:** (based on number of "Cowardin" ***vegetated*** classes present [do not include unvegetated classes], see #10 above)

# of "Cowardin" vegetated classes present in AA (see #10)	≥ 3 vegetated classes (or ≥ 2 if one is forested)	2 vegetated classes (or 1 if forested)	≤ 1 vegetated class
Rating (circle)	High	Moderate	Low

Comments: See Item 10.

SECTION PERTAINING to FUNCTIONS & VALUES ASSESSMENT

14A. Habitat for Federally Listed or Proposed Threatened or Endangered Plants or Animals:

I. AA is Documented (D) or Suspected (S) to contain (circle one based on definitions contained in instructions):

Primary or critical habitat (**list species**)	D	S	
Secondary habitat (list species)	D	S	
Incidental habitat (list species)	D	S	Canada lynx
No usable habitat	D	S	bald eagle, gray wolf, black-footed ferret, grizzly bear, Ute ladies'-tresses

II. Rating (use the conclusions from i above and the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function)

Highest Habitat Level	doc./primary	sus/primary	doc./secondary	sus./secondary	doc./incidental	sus./incidental	None
Functional Points and Rating	1 (H)	.9 (H)	.8 (M)	.7 (M)	.5 (L)	.3 (L)	0 (L)

Sources for documented use (*e.g.* observations, records, etc):
Montana Tunnels Mine Expansion Project reports: WESTECH Environmental Services, Inc. (2004 a,b,c, d); Culwell *et al*. (1984); Farmer *et al.* (1985).

14B. Habitat for plant or animals rated S1, S2, or S3 by the Montana Natural Heritage Program: (not including species listed in14A above)

i. AA is Documented (D) or Suspected (S) to contain (circle one based on definitions contained in instructions):

Primary or critical habitat (list species)	D	S	
Secondary habitat (list species)	D	S	
Incidental habitat (**list species**)	D	S	Musk-root (*Adoxa moschatellina*)
No usable habitat	D	S	several plant and animal species listed by MTNHP

II. Rating (use the conclusions from i above and the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function)

Highest Habitat Level	doc./primary	sus/primary	doc./secondary	sus./secondary	doc./incidental	sus./incidental	None
Functional Points and Rating	1 (H)	.8 (H)	.7 (M)	.6 (M)	.2 (L)	.1 (L)	0 (L)

Sources for documented use (*e.g.* observations, records, etc.):
Montana Tunnels Mine Expansion Project reports: WESTECH Environmental Services, Inc. (2004 a,b,c, d); Culwell *et al*. (1984); Farmer *et al.* (1985).

14C. General Wildlife Habitat Rating:

i. Evidence of overall wildlife use in the AA (circle substantial, **moderate**, or low based on supporting evidence):

Substantial (based on any of the following [check]):
__ observations of abundant wildlife #'s or high species diversity (during any period)
__ abundant wildlife sign such as scat, tracks, nest structures, game trails, etc.
__ presence of extremely limiting habitat features not available in the surrounding area
__ interviews with local biologists with knowledge of the AA

Low (based on any of the following [check]):
__ few or no wildlife observations during peak use periods
__ little to no wildlife sign
__ sparse adjacent upland food sources
__ interviews with local biologists with knowledge of the AA

Moderate (based on any of the following [check]):
X observations of scattered wildlife groups or individuals or relatively few species during peak periods
X common occurrence of wildlife sign such as scat, tracks, nest structures, game trails, etc.

X adequate adjacent upland food sources
X interviews with local biologists with knowledge of the AA

ii. Wildlife habitat features (working from top to bottom, circle appropriate AA attributes in matrix to arrive at exceptional (E), high (H), moderate (M), or low (L) rating. Structural diversity is from #13. For class cover to be considered evenly distributed, vegetated classes must be within 20% of each other in terms of their percent composition of the AA (see #10). Abbreviations for surface water durations are as follows: P/P = permanent/perennial; S/I = seasonal/intermittent; T/E = temporary/ephemeral; and A = absent [see instructions for further definitions of these terms].)

Structural diversity (see #13)	**High**								Moderate								Low			
Class cover distribution (all vegetated classes)	Even				**Uneven**				Even				Uneven				Even			
Duration of surface water in ≥10% of AA	P/P	S/I	T/E	A	P/P	**S/I**	T/E	A	P/P	S/I	T/E	A	P/P	S/I	T/E	A	P/P	S/I	T/E	A
Low disturbance at AA (see #12i)	**E**	**E**	**E**	**H**	**E**	**E**	**H**	**H**	**E**	**H**	**H**	**M**	**E**	**H**	**M**	**M**	**E**	**H**	**M**	**M**
Moderate disturbance at AA (see #12i)	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**H**	**M**	**M**	**L**	**H**	**M**	**L**	**L**
High disturbance at AA (see #12i)	**M**	**M**	**M**	**L**	**M**	**M**	**L**	**L**	**M**	**M**	**L**	**L**	**M**	**L**	**L**	**L**	**L**	**L**	**L**	**L**

iii. Rating (use the conclusions from i and ii above and the matrix below to arrive at [circle] the functional points and rating [E = exceptional, H = high, M = moderate, or L = low] for this function)

Evidence of wildlife use (i)	*Wildlife habitat features rating (ii)*			
	Exceptional	High	Moderate	Low
Substantial	1 (E)	.9 (H)	.8 (H)	.7 (M)
Moderate	.9 (H)	.7 (M)	.5 (M)	.3 (L)
Minimal	.6 (M)	.4 (M)	.2 (L)	.1 (L)

Comments: The location of the AA between highly disturbed conditions (mine pit) and moderately disturbed conditions justifies splitting the difference and assigning a total of .6.

14D. **General Fish/Aquatic Habitat Rating:** (Assess this function if the AA is used by fish or the existing situation is "correctable" such that the AA could be used by fish [i.e., fish use is precluded by perched culvert or other barrier, etc.]. If the AA is not or was not historically used by fish due to lack of habitat, excessive gradient, etc., circle **NA** here and proceed to the next function. If fish use occurs in the AA but is not desired from a resource management perspective [such as fish use within an irrigation canal], then Habitat Quality [i below] should be marked as "Low", applied accordingly in ii below, and noted ih the comments.)

i. Habitat Quality (circle appropriate AA attributes in matrix to arrive at exceptional (E), high (H), moderate (M), or low (L) quality rating.

Duration of surface water in AA	Permanent / Perennial			Seasonal / Intermittent			Temporary / Ephemeral		
Cover - % of waterbody in AA containing cover objects such as submerged logs, large rocks & boulders, overhanging banks, floating-leaved vegetation, etc.	>25%	10–25%	<10%	>25%	10–25%	**<10%**	>25%	10–25%	<10%
Shading - >**75%** of streambank or shoreline within AA contains riparian or wetland scrub-shrub or forested communities	E	E	H	H	H	M	M	M	M
Shading – **50 to 75%** of streambank or shoreline within AA contains rip. or wetland scrub-shrub or forested communities	H	H	M	M	M	M	M	L	L
Shading - < **50%** of streambank or shoreline within AA contains rip. or wetland scrub-shrub or forested communities	H	M	M	M	L	L	L	L	L

ii. Modified Habitat Quality (Circle the appropriate response to the following question. If answer is Y, then reduce rating in i above by one level [E = H, H = M, M = L, L = L]). *Is fish use of the AA precluded or significantly reduced by a culvert, dike, or other man-made structure or activity* ***or*** *is the waterbody included on the MDEQ list of waterbodies in need of TMDL development with listed "Probable Impaired Uses" including cold or warm water fishery or aquatic life support?* **Y** **N** Modified habitat quality rating = (circle) **E** **H** **M** **L**

iii. Rating (use the conclusions from i and ii above and the matrix below to arrive at [circle] the functional points and rating [E = exceptional, H = high, M =moderate, or L = low] for this function)

Types of fish known or suspected within AA	*Modified Habitat Quality (ii)*			
	Exceptional	High	Moderate	Low
Native game fish	1 (E)	.9 (H)	.7 (M)	.5 (M)
Introduced game fish	.9 (H)	.8 (H)	.6 (M)	.4 (M)
Non-game fish	.7 (M)	.6 (M)	.5 (M)	.3 (L)
No fish	.5 (M)	.3 (L)	.2 (L)	.1 (L)

Comments: The higher value of .9 was selected.

14E. **Flood Attenuation:** (applies only to wetlands subject to flooding via in-channel or overbank flow. If wetlands in AA are not flooded from in-channel or overbank flow, circle **NA** here and proceed to next function.)

i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function)

Estimated wetland area in AA subject to periodic flooding	≥ 10 acres			<10, >2 acres			≤2 acres		
% of flooded wetland classified as forested, scrub/shrub, or both	75%	25-75%	<25%	75%	25-75%	<25%	75%	25-75%	<25%
AA contains **no outlet or restricted outlet**	1(H)	.9(H)	.6(M)	.8(H)	.7(H)	.5(M)	.4(M)	.3(L)	.2(L)
AA contains **unrestricted outlet**	.9(H)	.8(H)	.5(M)	.7(H)	.6(M)	.4(M)	.3(L)	.2(L)	.1(L)

ii. Are residences, businesses, or other features which may be significantly damaged by floods located within 0.5 miles downstream of the AA (circle)? **Y** **N**

Comments: The Clancy Creek road parallels Clancy Creek downstream of the AA and is elevated high enough to avoid flooding.

14F. Short and Long Term Surface Water Storage: (Applies to wetlands that flood or pond from overbank or in-channel flow, precipitation, upland surface flow, or groundwater flow. If no wetlands in the AA are subject to flooding or ponding, circle **NA** here and proceed with the evaluation.)

i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function. Abbreviations for surface water durations are as follows: P/P = permanent/perennial; S/I = seasonal/intermittent; and T/E = temporary/ephemeral [see instructions for further definitions of these terms].)

Estimated maximum acre feet of water contained in wetlands within the AA that are subject to periodic flooding or ponding	>5 acre feet			<5, >1 acre feet			≤1 acre foot		
Duration of surface water at wetlands within the AA	P/P	S/I	T/E	P/P	S/I	T/E	P/P	S/I	T/E
Wetlands in AA flood or pond ≥ **5 out of 10 years**	1(H)	.9(H)	.8(H)	.8(H)	.6(M)	.5(M)	.4(M)	.3(L)	.2(L)
Wetlands in AA flood or pond **< 5 out of 10 years**	.9(H)	.8(H)	.7(M)	.7(M)	.5(M)	.4(M)	.3(L)	.2(L)	.1(L)

Comments: Clancy Creek is not subject to frequent flooding in the AA since it is located high up in the watershed; however, limited ponding does occur in the AA.

14G. Sediment/Nutrient/Toxicant Retention and Removal: (Applies to wetlands with potential to receive excess sediments, nutrients, or toxicants through influx of surface or ground water or direct input. If no wetlands in the AA are subject to such input, circle **NA** here and proceed with the evaluation.)

i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function.

Sediment, nutrient, and toxicant input levels within AA	AA receives or surrounding land use with potential to deliver low to moderate levels of sediments, nutrients, or compounds such that other functions are not substantially impaired. Minor sedimentation, sources of nutrients or toxicants, or signs of eutrophication present.				Waterbody on MDEQ list of waterbodies in need of TMDL development for "probable causes" related to sediment, nutrients, or toxicants or AA receives or surrounding land use with potential to deliver high levels of sediments, nutrients, or compounds such that other functions are substantially impaired. Major sedimentation, sources of nutrients or toxicants, or signs of eutrophication present.			
% cover of wetland vegetation in AA	≥ 70%		< 70%		≥ 70%		< 70%	
Evidence of flooding or ponding in AA	Yes	No	Yes	No	Yes	No	Yes	No
AA contains **no or restricted outlet**	1 (H)	.8 (H)	.7 (M)	.5 (M)	.5 (M)	.4 (M)	.3 (L)	.2 (L)
AA contains **unrestricted outlet**	.9 (H)	.7 (M)	.6 (M)	.4 (M)	.4 (M)	.3 (L)	.2 (L)	.1 (L)

Comments: Clancy Creek in the AA (and downstream) is on the TMDL list and percent vegetation cover exceeds 70 percent; however, there is no restricted outlet.

14H Sediment/Shoreline Stabilization: (applies only if AA occurs on or within the banks or a river, stream, or other natural or man-made drainage, or on the shoreline of a standing water body which is subject to wave action. If does not apply, circle **NA** here and proceed to next function)

i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [E = exceptional, H = high, M = moderate, or L = low] for this function.

% Cover of wetland streambank or shoreline by species with deep, binding rootmasses	Duration of surface water adjacent to rooted vegetation		
	permanent / perennial	seasonal / intermittent	Temporary / ephemeral
≥ 65%	1 (H)	.9 (H)	.7 (M)
35-64%	.7 (M)	.6 (M)	.5 (M)
< 35%	.3 (L)	.2 (L)	.1 (L)

Comments: Vegetation in the AA is dominated by shrubs and trees.

14I. Production Export/Food Chain Support:
i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function. Factor A = acreage of vegetated component in the AA; Factor B = structural diversity rating from #13; Factor C = whether or not the AA contains a surface or subsurface outlet; the final three rows pertain to duration of surface water in the AA, where P/P = permanent/perennial; S/I = seasonal/intermittent; T/E /A= temporary/ephemeral or absent [see instructions for further definitions of these terms].)

A	Vegetated component >5 acres						Vegetated component 1-5 acres						Vegetated component <1 acre					
B	High		Moderate		Low		High		Moderate		Low		High		Moderate		Low	
C	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	1H	.9H	.9H	.8H	.8H	.7M	.9H	.8H	.8H	.7M	.7M	.6M	.7M	.6M	.6M	.4M	.4M	.3L
	.9H	.8H	.8H	.7M	.7M	.6M	.8H	.7M	.7M	.6M	.6M	.5M	.6M	.5M	.5M	.3L	.3L	.2L
T/E/A	.8H	.7M	.7M	.6M	.6M	.5M	.7M	.6M	.6M	.5M	.5M	.4M	.5M	.4M	.4M	.2L	.2L	.1L

Comments: There is no restricted outlet on Clancy Creek in the AA.

14J. Groundwater Discharge/Recharge: (Check the indicators in i & ii below that apply to the AA)

i. Discharge Indicators
- _X_ Springs are known or observed
- _X_ Vegetation growing during dormant season/drought
- ___ Wetland occurs at the toe of a natural slope
- ___ Seeps are present at the wetland edge
- ___ AA permanently flooded during drought periods
- ___ Wetland contains an outlet, but no inlet
- ___ Other

ii. Recharge Indicators
- ___ Permeable substrate present without underlying impeding layer
- ___ Wetland contains inlet but no outlet
- ___ Other

iii. Rating: Use the information from i and ii above and the table below to arrive at [circle] the functional points and rating [H = high, L = low] for this function.

Criteria	Functional Points and Rating
AA is known Discharge/Recharge area or one or more indicators of D/R present	1 (H)
No Discharge/Recharge indicators present	.1 (L)
Available Discharge/Recharge information inadequate to rate AA D/R potential	N/A (Unknown)

Comments: Springs are present in the tributary to Clancy Creek in the AA. Clancy Creek in vicinity of the mine pit is a perched aquifer.

14K. Uniqueness:
i. Rating (working from top to bottom, use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function.

Replacement potential	AA contains fen, bog, warm springs or mature (>80 yr-old) forested wetland **or** plant association listed as "S1" by the MNHP			AA does not contain previously cited rare types and structural diversity (#13) is high or contains plant association listed as "S2" by the MNHP			AA does not contain previously cited rare types or associations and structural diversity (#13) is low-moderate		
Estimated relative abundance (#11)	rare	common	abundant	rare	common	abundant	rare	commo n	abundant
Low disturbance at AA (#12i)	1 (H)	.9 (H)	.8 (H)	.8 (H)	.6 (M)	.5 (M)	.5 (M)	.4 (M)	.3 (L)
Moderate disturbance at AA (#12i)	.9 (H)	.8 (H)	.7 (M)	.7 (M)	.5 (M)	.4 (M)	.4 (M)	.3 (L)	.2 (L)
High disturbance at AA (#12i)	.8 (H)	.7 (M)	.6 (M)	.6 (M)	.4 (M)	.3 (L)	.3 (L)	.2 (L)	.1 (L)

Comments: Plant communities in AA are generally common in region, however, AA has high structural diversity and (generally) low disturbance.

14L. Recreation/Education Potential: i. Is the AA a known rec./ed. site: (circle) Y **N** (If yes, rate as [circle] High [1] and go to ii; if no go to iii)

ii. Check categories that apply to the AA: ___ Educational/scientific study; __Consumptive rec.;__Non-consumptive rec.; ___Other

iii. Based on the location, diversity, size, and other site attributes, is there strong potential for rec./ed. use? Y **N**

(If yes, go to ii, then proceed to iv; if no, then rate as [circle] Low [0.1])

iv. Rating (use the matrix below to arrive at [circle] the functional points and rating [H = high, M = moderate, or L = low] for this function.

Ownership	*Disturbance at AA (#12i)*		
	low	moderate	high
public ownership	1 (H)	.5 (M)	.2 (L)
private ownership	.7 (M)	.3 (L)	.1 (L)

Comments: Public access is partially restricted due to proximity to operating mine. Based on dual moderate to high disturbance rating (12i) and private ownership, a value of 0.2 is appropriate.

FUNCTION & VALUE SUMMARY & OVERALL RATING

Function & Value Variables	Rating	Actual Functional Points	Possible Functional Points	Functional Units; (Actual Points x Estimated AA Acreage)
A. Listed/Proposed T&E Species Habitat	L	0.3	1	
B. MT Natural Heritage Program Species Habitat	L	0.1	1	
C. General Wildlife Habitat	M	0.6	1	
D. General Fish/Aquatic Habitat	H	0.9	1	
E. Flood Attenuation	H	0.7	1	
F. Short and Long Term Surface Water Storage	L	0.3	1	
G. Sediment/Nutrient/Toxicant Removal	M	0.4	1	
H. Sediment/Shoreline Stabilization	M	0.7	1	
I. Production Export/Food Chain Support	H	1.0	1	
J. Groundwater Discharge/Recharge	H	1.0	1	
K. Uniqueness	M	0.5	1	
L. Recreation/Education Potential	L	0.2	1	
Totals:	L-H	6.7	12	

OVERALL ANALYSIS AREA (AA) RATING: (Circle appropriate category based on the criteria outlined below) **I** **II** **III** **IV**

Category I Wetland: (Must satisfy **one** of the following criteria; if does not meet criteria, go to Category II)

___ Score of 1 functional point for Listed/Proposed Threatened or Endangered Species; **or**
___ Score of 1 functional point for Uniqueness; **or**
___ Score of 1 functional point for Flood Attenuation **and** answer to Question 14E.ii is "yes"; **or**
___ Total actual functional points > 80% (round to nearest whole #) of total possible functional points.

Category II Wetland: (Criteria for Category I not satisfied **and** meets any **one** of the following criteria; if not satisfied, go to Category IV)

___ Score of 1 functional point for Species Rated S1, S2, or S3 by the MT Natural Heritage Program; **or**
___ Score of .9 or 1 functional point for General Wildlife Habitat; **or**
_X_ Score of .9 or 1 functional point for General Fish/Aquatic Habitat; **or**
___ "High" to "Exceptional" ratings for **both** General Wildlife Habitat **and** General Fish/Aquatic Habitat; **or**
___ Score of .9 functional point for Uniqueness; **or**
___ Total Actual Functional Points > 65% (round to nearest whole #) of total possible functional points.

Category III Wetland: (Criteria for Categories I, II or IV not satisfied)

Category IV Wetland: (Criteria for Categories I or II are not satisfied and all of the following criteria are met; if does not satisfy criteria go to Category III)

___ "Low" rating for Uniqueness; **and**
___ "Low" rating for Production Export/Food Chain Support; **and**
___ Total actual functional points < 30% (round to nearest whole #) of total possible functional points

Literature Cited

Culwell, L.D., K.L. Scow and L.A. Larsen. 1984. Vegetation inventory of the Montana Tunnels study area, Jefferson County, Montana. Unpublished technical report prepared for Centennial Minerals, Inc., by Western Technology and Engineering, Inc. (WESTECH), Helena, Montana. 87 p.

Farmer, P.J., S.B. Heath, D.J. Bergeron and K.L. Scow. 1985. Montana Tunnels Project baseline terrestrial wildlife survey. Tech. rep. by Western Technology and Engineering, Inc. (WESTECH) for Centennial Minerals, Inc., Helena, Montana.

Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, University of Montana, Missoula. 646 p.

WESTECH Environmental Services, Inc. (WESTECH). 2004a. Vegetation inventory, Montana Tunnels Mine expansion, Jefferson County, Montana. Unpub. tech. rep. for Apollo Gold, Jefferson City, Montana.

WESTECH Environmental Services, Inc. (WESTECH). 2004b. Report 15: fisheries information, proposed Montana Tunnels Mine expansion. Unpub. tech. rep. for Montana Tunnels Mining, Inc., Jefferson City, Montana.

WESTECH Environmental Services, Inc. (WESTECH). 2004c. Wetlands inventory, Montana Tunnels Mine expansion, Jefferson County, Montana. Unpub. tech. rep. for Apollo Gold, Jefferson City, Montana.

WESTECH Environmental Services, Inc. (WESTECH). 2004d. Report 16: Wildlife information, proposed Montana Tunnels Mine expansion. Unpub. tech. rep. for Montana Tunnels Mining, Inc., Jefferson City, Montana.

ATTACHMENT A-3

Performance Standards for Compensatory Mitigation

ATTACHMENT A-3

Performance standards for compensatory mitigation

Created Wetland Size:	Not less than 3.00 acres of palustrine emergent, scrub-shrub and forested wetland will be created at the Clancy Creek mitigation site. Not less than 2.13 acres of scrub/shrub and emergent wetland will be reestablished to replace wetlands affected within the mitigation site. Total wetland to be created/reestablished will not be less than 5.13 acres. Size will be based on GPS or civil survey mapping of areas meeting U.S. Army Corps of Engineers (Corps) criteria for wetlands (at least one positive indicator of wetland hydrology, hydric soils and hydrophytic vegetation).
Stream Channel Reestablishment:	Not less than 3,000 lineal feet of stream channel will be created.
Water Regime:	The sites will be saturated within 12 inches of the surface or inundated to a depth not exceeding six inches for at least 22 days during the growing season.
Soils: Vegetation: Functions and Values:	Soils will be seasonally saturated or inundated for at least 22 days during the growing season. 1. At least 50 percent of the dominant species in designated wetlands will be obligate (OBL), facultative wetland (FACW) or facultative (FAC) within three years. 2. Stratified canopy of shrubs in designated scrub-shrub wetlands will be 30 percent or shrub mortality will be less than 50 percent after three years. 3. Stratified canopy of trees in designated forested wetlands will be 10 percent or tree mortality will be less than 50 percent after three years. 4. Exotic species that may inhibit establishment or development of planted species will not exceed 25 percent canopy cover after three years unless it appears that stand succession will proceed, based on an analysis of trend, to create a plant community capable of providing wildlife habitat. 5. Vegetation types will be created to achieve the following proportion of types: Forested 25-30 percent Scrub/shrub 60-70 percent Emergent 5-15 percent The overall rating of the wetland mitigation sites will comparable to the affected sites as determined by the MDT Montana Wetland Assessment Method (Attachment A).

APPENDIX B: GEOCHEMICAL TESTING TECHNICAL REPORT

Geochemical Testing

Technical Report

Prepared by

Tetra Tech
P.O. Box 1413
Bozeman, MT 59771

May 2007

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APPENDICES

1.0 Introduction

Operations at the Montana Tunnels Mine involve ore recovery from the central portion of a diatreme associated with Elkhorn volcanics, Lowland Creek volcanics, Biotite Dikes, and Quartz Latite Dikes. Sulfide minerals and ore grade materials are primarily present in the diatreme as distributions within the breccia matrix and occasionally as veinlets. The gold-silver deposit is reported to have high concentrations of zinc, lead, and manganese and low concentrations of arsenic, antimony, bismuth, and mercury, with respect to other volcanic-hosted precious metal deposits (Sillitoe et al 1985).

Montana Tunnels Mining Inc. (MTMI) is proposing to expand operations to recover ore from lower elevations of the current open pit. The expansion would involve deepening and widening the existing pit but no changes to the ore processing method would be made. The Proposed Action could potentially alter geochemical behavior of ore, waste, and tailings materials and subsequently change the potential for acid generation and metal mobility from these materials, particularly if ore mined from the expansion has different geochemical qualities than previously mined ore.

MTMI has performed numerous geochemical tests on samples of ore, waste rock, and tailings in order to evaluate the behavior of these materials. The following document describes these tests and their results and is intended to supplement the less detailed discussion provided in Chapter 3 of this Environmental Impact Statement.

2.0 Waste Rock Characterization

Under the Proposed Action 168.5 million cubic yards of waste rock would be mined during the 5 year extension to mine life, in addition to that generated by the currently permitted Project. Waste lithologies that would be mined include low-grade (sub-ore grade) diatreme, Elkhorn volcanics, Lowland Creek volcanics (approximately 10% of which consists of biotite bearing dike material), and Quartz Latite Dike (**Table 1**).

TABLE 1
Montana Tunnels Mine Waste Rock Volumes

Material	Life-of-Mine Through L-Pit	Life-of-Mine Through M-Pit	Net Change (M-Pit Mine Expansion Only)
	Volume (million cubic yards)		
Low Grade Diatreme	61.4	91.8	30.4
Quartz Latite Dike	18.9	22.9	4.0
Lowland Creek Volcanics (1)	21.5	25.8	4.3
Elkhorn Volcanics	20.5	28.0	7.5
Total	122.3	168.5	46.2

[1] Approximately 10 % of the total volume of Lowland Creek Volcanics is contributed by biotite bearing dike material.

Waste rock samples have been subjected to geochemical tests to evaluate the potential for acid generation and metal mobility from the various lithologies (Table A1 in **Appendix A**). Most of this testing is discussed in detail in appendices of the Pit Lake Flooding and Water Quality Modeling report by Knight Piesold (2001). In many cases testing was performed on samples of a certain lithology that also contained minor amounts of an associated lithology, for example Elkhorn volcanics with diatreme breccia.

The data indicate that waste rock does not generate acidic leachate. Kinetic tests consistently fail to produce acid from samples predicted to be acid generating during static tests. Manganese was mobilized from all waste rock types, frequently exceeding DEQ-7 standards applicable to receiving waters (i.e. Spring Creek which has a hardness of about 230 mg/l). Concentrations of iron and zinc were not found to exceed DEQ-7 standards.

2.1 Acid Generation Potential from Waste Rock

Data for assessing the potential for acid generation from waste rock includes results of static acid-base account testing, kinetic tests (long term column leach tests, bottle roll tests, and batch reaction tests using tailings reclaim water), and water quality data from monitoring wells located downgradient of the existing waste rock dump.

Initial kinetic tests failed to produce acidic leachate from samples predicted to become acidic by static testing and resulted in further study by a number of investigators. These studies and their results are discussed in Section 3.5 separately from primary characterization data that are presented here.

Static tests were performed on approximately 1900 samples. Most samples analyzed for ABA characteristics are those delineated waste samples separated from ore within ore control blast patterns. More recently (2004-2005) entire drill patterns have been analyzed as a composite of all blast holes in the pattern to more thoroughly delineate the ABA characteristics of the resulting mine surfaces by bench elevation as the mine advances toward and into the core ore zone at the lower elevations of the open pit. Many of these composites are a mixture of ore and waste in varying proportions depending upon the location and design of the blast pattern. Because of this sampling strategy it is not possible to distinguish between waste rock lithologies.

The USBLM (1996) uses NP:AP (neutralization potential : acidification potential) ratios and NNP (net neutralization potential) values to evaluate potential for rock to generate acid. Rock is assumed to be potentially acid generating if NP:AP ≤ 1.0 and NNP ≤ 20 tons CaCO3 per kiloton (tons/kton) rock material. Rock is not be considered potentially acid generating if NP:AP ≥ 3.0 and NNP ≥ 20 tons/kton. For samples having NP:AP between 1.0 and 3.0, or NNP between -20 and 20 tons/kton, the rock has uncertain potential to generate acid.

A majority of samples from the Montana Tunnels sampling program are indicated by static test data to have the potential to generate acid or to have uncertain acid generating potential (**Figure 1**). However, as discussed below, samples indicated by static testing to be acid producing do not generate acid during kinetic testing and therefore the use of static test data to evaluate acidification potential of Montana Tunnels rock is conservative. To date, the current waste rock storage pile has not generated acid upon exposure to weathering conditions.

Despite the lack of acidification from waste rock previously mined at Montana Tunnels and the conservative nature of static test data for this site, a statistical analysis (one-way ANOVA) comparing NP:AP values by 500-foot increments in pit elevation shows that NP:AP values decrease significantly with depth in the pit (**Appendix B**) (Statistical Package for Social Science, Inc. 1997). **Figure 2** shows that rock mined below 5,100 feet in elevation has a significantly greater potential to generate acid, based on static tests, compared to rock mined higher in the pit. This may be due to a greater amount of sulfide mineralized ore material contained in blast pattern composite samples collected from lower pit elevations due to pit geometry that narrows into the ore body at depth. However, it is also possible that material from low pit elevations was not exposed to meteoric weathering and oxidation to the same extent as material at higher pit elevations. The available data do not allow for a conclusive determination as to why M-Pit Mine Expansion material appears to have greater concentrations of sulfide.

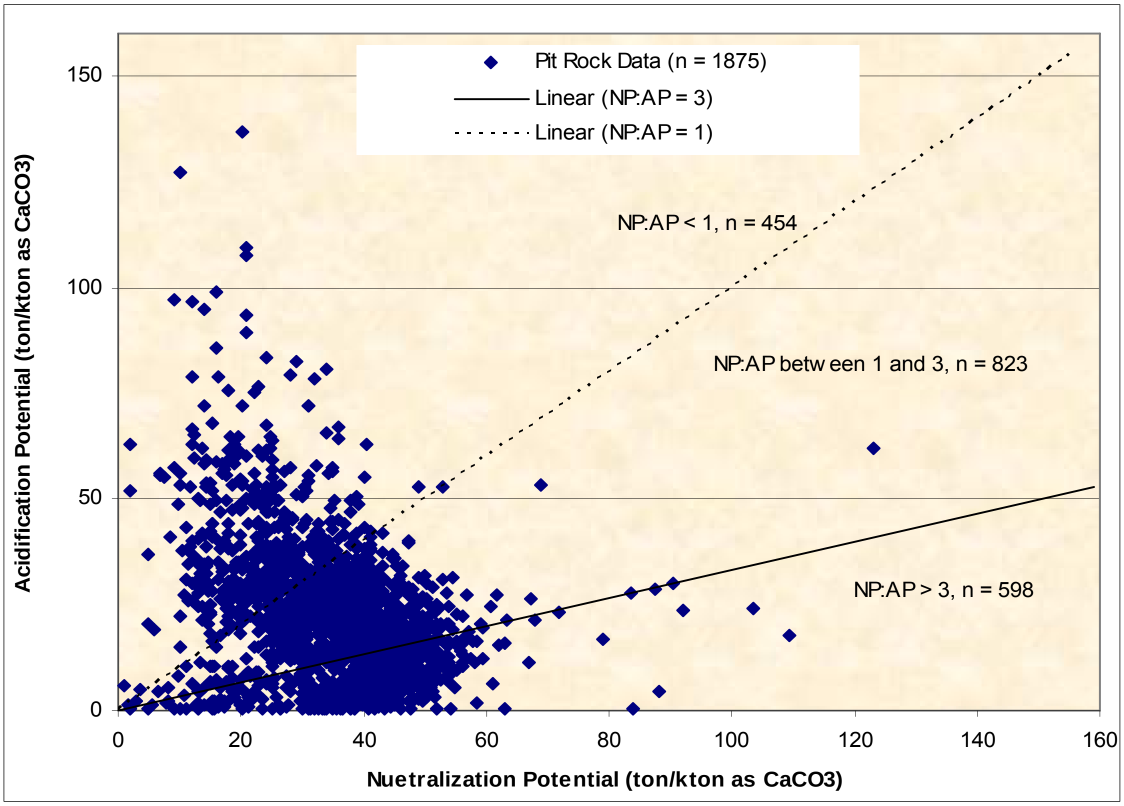


Figure 1. Acid base account data for Montana Tunnels waste rock.

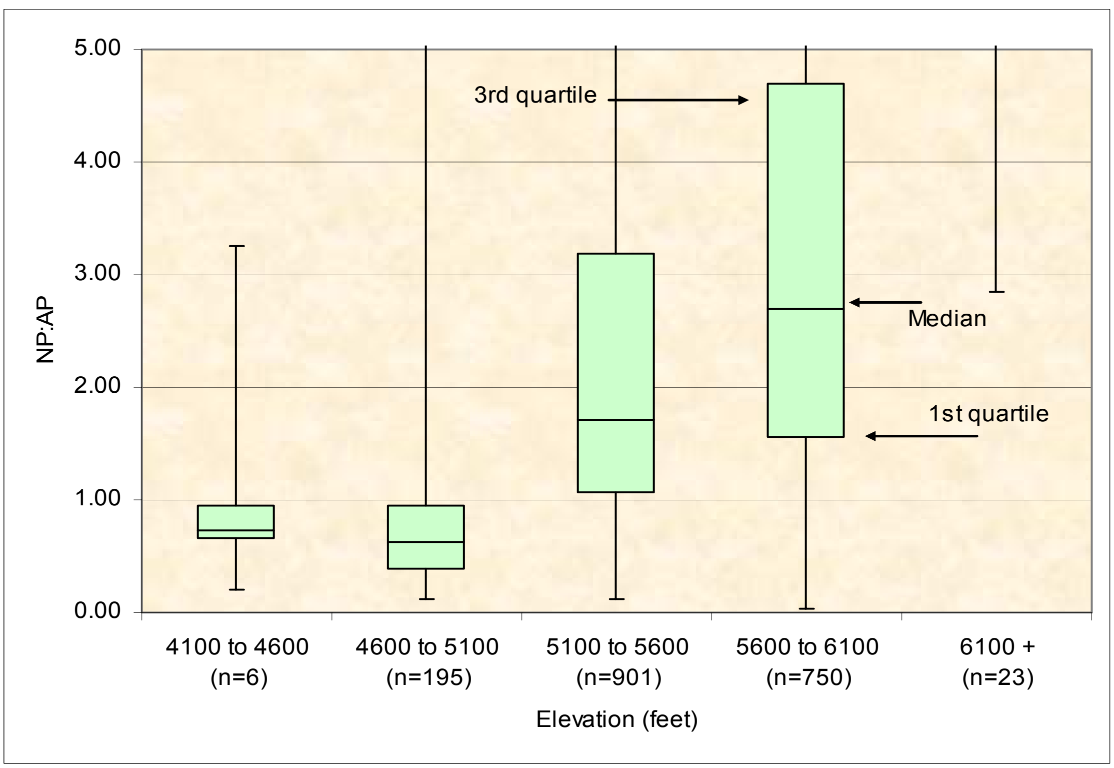


Figure 2. Comparison of acid base account data by depth.

Kinetic tests performed on MTMI waste rock include long-term (approximately 14 years) column leach testing on two samples of diatreme waste rock collected from the open pit and waste dump pile (Knight Piesold 2001). These tests were initiated prior to development of the ASTM standard method and were not expected to be long-term tests at the time they were initiated. Consequently, the timing and duration of air circulation and leaching cycles and the volume of water applied to the columns varied throughout the test period. Interpretation of the column data is further complicated by a switch from glass wool to polyester wool in June 1994 after it was determined that glass wool caused an increase in effluent pH and by transferring the diatreme samples from columns to pans in November 1995 after continual plugging of columns.

Effluent collected from both waste rock columns maintained neutral to slightly basic pH values during the entire 14 year test period that ranged from 6.50 to 9.53 (Figures C1 and C2 in **Appendix C**). Differences existed between the columns with respect to trends in cumulative alkalinity and sulfate release.

Cumulative alkalinity was greater than cumulative sulfate release during the entire test period for samples in both columns #2 (nonacid-generating waste dump perimeter), and #3 (5630-27 Shot), suggesting that any alkalinity was released at a grater rate than acidity and that any acidity released would be readily neutralized. Acidity concentrations were not reported. Static testing of the diatreme samples in these columns indicated that column # 2 had no potential for acid generation (NNP = 33 tons/kton, NP:AP = 3.3) while column #3 had uncertain acid generating potential (NNP = 3 tons/kton, NP:AP = 1.1).

Seven samples representative of waste rock were subjected to 16-hour bottle roll tests whereby rock samples were mixed with water for 16 hours, the water was extracted, and the samples were allowed to rest for 8 hours before beginning another extraction cycle (Knight Piesold 2001). Six extractions were performed in order to evaluate the behavior of rock exposed on pit highwalls when contacted with natural precipitation. Three samples of diatreme waste were tested as well as one sample each of Biotite Dike, Elkhorn volcanics, Lowland Creek volcanics, and Quartz Latite Dike waste rock.

All waste rock samples produced extracts with neutral to slightly basic pH values ranging from 7.56 to 8.87 (Figures C7 through C14 in **Appendix C**). Static test results for the Elkhorn volcanic sample and one diatreme sample collected from the south side of the pit indicated that the samples had uncertain acid generating potential based on the BLM criteria. The remaining samples were not expected to generate acid based on static test results. Cumulative alkalinity loads were greater and increased at a greater rate compared to cumulative sulfate loads for all samples.

Splits of the rock samples used for 16-hour bottle roll testing were also subjected to batch reaction testing where rock samples were combined with mill reclaim water

composed of recycled tailings water, tailings under drain water, recovery well water, and fresh makeup water as fed to the milling operations. This test was performed to evaluate the behavior of samples when contacted with tailings storage facility water upon mine closure and pit flooding procedures. Three splits of each rock type were combined with the reclaim water and agitated for various lengths of time (seven, 15, and 30 days) before the solution was drained and analyzed.

The reclaim water had an initial pH of 7.52 which increased to values of 7.66 to 8.23 after contact with the rock samples (Figures C16 through C22 in **Appendix C**). Sulfate loads exceeded alkalinity loads in all sample extracts because the reclaim water had very high sulfate concentrations prior to interaction with the rock samples.

Neutral pH values in groundwater monitored in wells downgradient of existing waste rock storage areas show no evidence of acidification from leachate infiltrating the waste rock dump. Impacts to water resources (ARD and metal concentrations) are associated with the nearby historic Minah, Blue Bird, Washington, and Alta mine sites. However those mines were developed in wide sulfide mineral veins while mineralization at Montana Tunnels consists of sulfide mineral disseminations within a breccia matrix and in widely spaced veinlets emplaced 20 million years after the mineralizing event at the historic mines (MTMI 2005).

2.2 Metal Mobility Potential from Waste Rock

Waste rock metal mobility has been evaluated through long-term column leach tests, 16-hour bottle roll tests, and batch reaction tests with tailings reclaim water discussed above in Section 2.1. Data from these tests are summarized in Table D1 in **Appendix D**. Very little variation was observed with respect to metal concentrations between extractions for a given sample for either test, therefore the data are presented as the mean and range for each sample.

Data is compared to the lowest applicable surface water standard reported in the 2006 edition of the Circular DEQ-7 Montana Numeric Water Quality Standards (Table D1). Hardness dependent standards have been calculated for water with a hardness of 230 mg/l to represent receiving waters in Spring Creek.

Long-term column leach tests were intended to provide data for assessment of long term acid production potential. Therefore metal mobility data from the columns are limited to dissolved metal concentrations measured in five effluent samples collected from each of the two columns after nine years of leaching had occurred. These data are useful for predicting long-term steady-state metal release but are not applicable to predictions of short term release during mine operations or soon after closure.

Table D1 displays metals analyzed during long-term column leach testing. Most concentrations were near or below detection limits for both of the diatreme waste samples. Arsenic, cadmium, and lead were reported below the method detection limit for both samples. It should be noted that the DEQ-7 standards for surface water are based on total recoverable concentrations while long-term column leach test data are for dissolved metals.

Total metal concentrations were measured in extracts collected during 16-hour bottle roll tests. During these tests rock samples were crushed and sieved to between 0.85 and 3.35 mm and mixed with distilled water to represent waste rock in dumps or pit highwalls in contact with precipitation. The test design did not facilitate oxidation reactions (i.e. it allowed only relatively short 8-hour "rest" periods and no circulation of air between extraction cycles) and therefore accumulation and subsequent dissolution of soluble salts would not be expected to have occurred on rock surfaces to the extent possible in the field setting. However, the small particle size of the tested material compared to in-situ rock does add a degree of conservatism to the predicted metal concentrations.

Total metals concentrations were in many cases near or below detection limits. Maximum concentrations shown in Table D1 were usually measured in the first extract from each rock sample and become stable afterwards. Mean concentrations of manganese exceeded DEQ-7 standards in extracts from most waste rock samples. Arsenic was above the DEQ-7 standard in all extracts from the Quartz Latite Dike sample. Iron and zinc did not exceed DEQ-7 standards.

Originally measured lead concentrations were found to have been biased by contamination introduced by filtering equipment (Knight Piesold, 2001). A distilled water blank with no detectable lead prior to filtering had a lead concentration of 0.157 mg/l after passing through the filter apparatus. Therefore a single extraction using the same water volume to rock mass ratio as the original bottle roll test was performed on new samples and these lead concentrations, which were all below detection, were substituted into the dataset. Lead concentrations did not exceed applicable standards.

Extracts from the tailings reclaim water interaction tests generally had water quality that was similar to the reclaim water and had elevated concentrations of the same elements described for the 16-hour bottle roll test (Table D1). Copper and barium concentrations were greater in test effluent from most waste samples compared to reclaim water but all barium and many copper concentrations remained below applicable standards. Iron, manganese, and zinc concentrations were lower in effluent samples compared to reclaim water indicating the potential for attenuation of these elements. These samples were affected by lead cross contamination however no repeated measurements were made to determine the extent of the contamination.

3.0 Ore Characterization

Under the Proposed Action an additional 28 million tons of ore would be mined during the 5 year extension to mine life. The polymetallic ore (low-grade gold, zinc, silver, and lead) within the Montana Tunnels deposit occurs in both veins and disseminations associated with a brecciated mass of volcanic diatreme. Ore processing operations would continue to use the same procedure as is currently permitted.

Ore-grade diatreme samples have been subjected to geochemical tests to evaluate the potential for acid generation and metal mobility from the various lithologies (Table A1 in **Appendix A**). Most of this testing is discussed in detail in appendices of the Pit Lake Flooding and Water Quality Modeling report by Knight Piesold (2001).

Although pH values remained neutral to slightly basic during leach testing, data from static tests indicate that ore samples may generate acid. Long term leach testing and bottle roll data testing yielded concentrations of manganese above DEQ-7 standards.

3.1 Acid Generation Potential from Ore

Kinetic tests performed on MTMI ore samples include long-term (approximately 14 years) column leach testing on four samples of diatreme ore collected from the open pit and stockpile (Knight Piesold 2001). As mentioned in Section 2.1, these tests were not expected to be long-term tests and treatment methods varied throughout the test period. Additional investigations included splits of one ore sample being subjected to the 16-hour bottle roll test and the tailings reclaim water interaction test.

Neutral to slightly basic pH was maintained by all column effluent for the duration of the 14 year test period. Values ranged from 6.38 to 8.97 (Figures C3, C4, C5, and C6 in **Appendix C**). Differences were observed in the cumulative alkalinity and sulfate release of the four columns.

In samples from column #1 (5470 Bench) cumulative alkalinity was greater than cumulative sulfate release throughout the duration of testing, implying that released acidity would, in turn, be readily neutralized. Acidity concentrations were not reported. Static testing of column #1 predicted this sample to have uncertain acid generating potential (NNP = -14 tons/kton, NP:AP data are not available).

While cumulative alkalinity continued to increase slightly, cumulative sulfate release was greater after approximately five and 11 years of leaching for columns #4 (5390 Bench) and #5 (5390-5 Shot), respectively. Static test results indicated these diatreme samples would generate acid (NNP of -57 and -17 tons/kton and NP:AP 0.0002 and 0.6) however pH values remained neutral to slightly basic during leach testing.

Cumulative sulfate release exceeded alkalinity at all times in column #6 (Stockpile) leachate but pH values remained above 6.4. Static testing indicated that this diatreme sample would produce acid (NNP of -48 tons tons/kton and NP:AP data are not available).

The potential for acidification from one ore sample was evaluated using the 16-hour bottle roll and tailings reclaim water interaction tests described in the waste rock characterization sections. Extract collected from the bottle roll procedures had neutral pH values of 7.78 to 7.94 and extract from the tailings reclaim water test had pH values of 7.98 to 8.19, greater than the pH of tailings reclaim water prior to interaction with the ore (7.52).

3.2 Metal Mobility Potential from Ore

Metal mobility data were collected from long term column leach, 16-hour bottle roll, and reclaim water interaction tests and include dissolved metal concentrations measured in test extracts (Table D2 in **Appendix D**).

Long term leach test extracts from columns #4 (5390 Bench) and #5 (5690-5 Shot), exceeded the standard for manganese. Column #6 also exceeded the standard for copper. No other standards were exceeded but it should be noted that these data are for dissolved metal concentrations while DEQ-7 surface water quality standards are based on total concentrations.

Bottle roll extracts collected from a single ore sample had total metal concentrations that were near detection limit levels in all but the first extract except for manganese. Manganese concentrations increased from 0.3 mg/l in the first extract to 0.6 mg/l in the fifth and sixth (final) extracts. As discussed in section 2.2, the original lead analysis was biased by cross contamination and was performed again on another sample. The resulting lead concentration was below detection (0.003 mg/l) and therefore was below the DEQ-7 standard for water with 230 mg/l hardness.

Concentrations of manganese and iron in extracts from tailings reclaim water interaction tests decreased compared to reclaim water prior to contact with the ore sample. Concentrations of cadmium and zinc increased with increased interaction time between the ore and reclaim water despite very low concentrations of these analytes in the 16-hour bottle roll test. Mean concentrations of cadmium, lead, manganese, and zinc were in excess of the respective DEQ-7 standards however data for lead were biased by cross contamination.

4.0 Tailings Storage Facility Characterization

Data for characterizing geochemical behavior of the tailings storage facility (TSF) include static and kinetic tests for acidification potential from tailings solids and water quality analyses for tailings water samples. The data show that tailings in the existing TSF have not generated acidic leachate. Water from the TSF has concentrations of iron, manganese, and cyanide that exceed standards.

4.1 Acid Generation Potential from Tailings

Acid base accounting data are available for 58 tailings samples and indicate that the tailings have the potential to generate acid (**Figure 3**) however, as discussed later in section 5.0, static tests have consistently predicted acid generation from materials shown not to become acidic during kinetic testing.

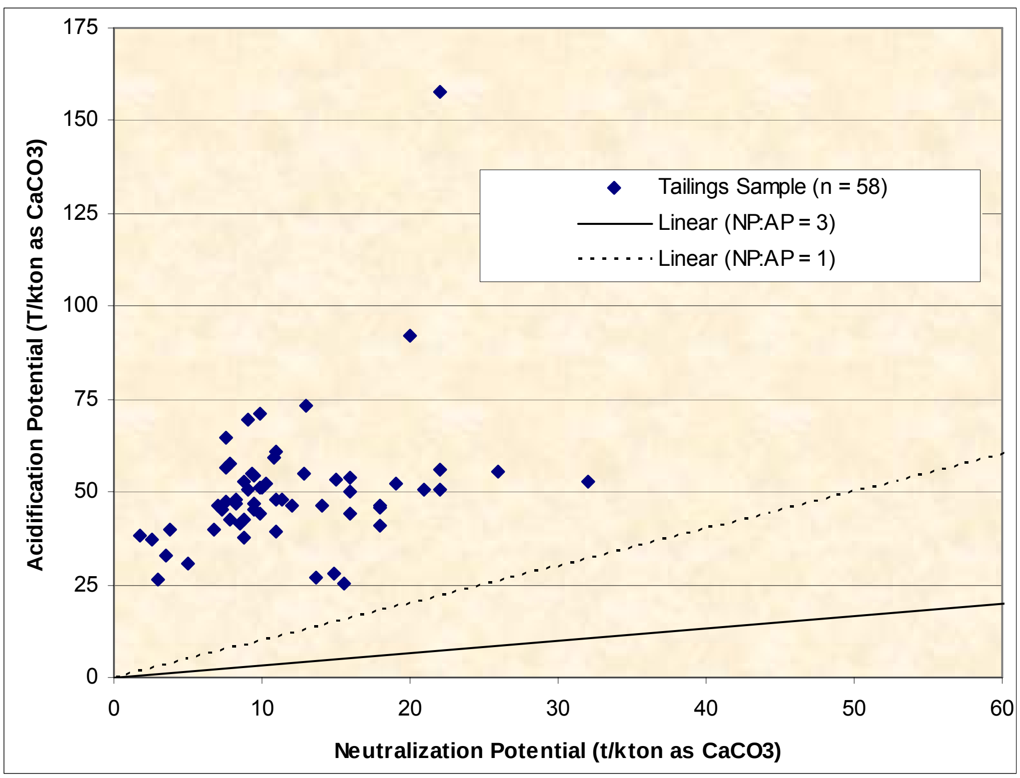


Figure 3. Acid base account data for Montana Tunnels tailings samples.

Table D3 (in **Appendix D**) reports pH data for tailings supernatant and drain water samples and tailings sand pore water samples. Values of pH are consistently neutral to slightly basic ranging from 6.60 to 8.15. Acid production potential from tailings was also assessed by university researchers using kinetic tests as summarized in Appendix 5 of Knight Piesold (2001). These researchers found that tailings samples predicted by static testing to generate acid did not become acidic during any of a variety of different kinetic tests.

4.2 Metal Mobility Potential from Tailings

Water quality samples collected from the TSF supernatant (i.e. pond water), underdrains, and embankment drains provide data for assessing potential metal mobility from the tailings solids. Data are also available from a tailings sands pore water evaluation and tailings reclaim water used in the milling process.

Summary statistics for selected analytes are reported in Table D3 (**Appendix D**). Current DEQ-7 water quality standards are included in the table as a reference. The table shows hardness dependent standards calculated for a hardness of 230 mg/l because this is the hardness of Spring Creek which would receive tailings facility seepage and also seepage from the pit lake. It should be noted that hardness in TSF water samples is much greater (above 500 mg/l) and therefore standards directly applicable to the TSF have greater values. It should also be noted that water quality standards are based on total concentrations while most TSF samples were analyzed for dissolved concentrations. This is because the TSF water contains clays and fine sulfides that result from ore grinding. These particles settle out over time and are not included in analysis as total recoverable analytes because they result in a variable and high bias. Solids settle out of the tailings water over time as it resides undisturbed in the impoundment.

Mean water quality data for tailings storage facility pond water, underdrain, and embankment drain samples collected from 1993 through 1999 indicate that cadmium, copper, lead, manganese, and cyanide exceeded the lowest applicable standards during this time period (Table D3 in **Appendix D**). Water quality samples from the tailings storage facility pond collected from 2001 through 2004 have lower concentrations compared to samples collected between 1993 and 1999 and exceeded standards for only manganese and cyanide.

Tailings storage facility embankment and underdrains were combined in the early 2000s (combined drains), and six samples were collected since 2002 (Table D3 in **Appendix D**). Mean data from the combined drains show that standards for iron, manganese, and cyanide are regularly exceeded.

Pore water data are available from a 25-pound sample of tailings sands (+200 mesh) that were leached with 4 gallons of mine pit dewatering water. The sands were loaded into a plastic column and the entire volume of water added. The column was sealed and 1000 ml samples were extracted once per month for three months and an additional sample was extracted approximately two and a half years after starting the test. Metal concentrations in dewatering water prior to contact with the tailings sands were below standards for all measured analytes except for copper (0.016 mg/l) and manganese (0.128 mg/l). Cadmium concentrations in the dewatering water were below detection prior to contact with tailings sands. Minimum concentrations were measured for all analytes in the extract sample collected after two and a half years of contact time while highest concentrations tended to be observed in the three month sample (Table D3 in **Appendix D**). Mean concentrations were below standards for all measured constituents except lead and manganese. Additionally, maximum concentrations exceeded standards for arsenic.

5.0 Comparison of Methods for Determining Neutralization Potential

Data presented above in discussions of static and kinetic tests of acid generating potential show that samples predicted by static testing to generate acid do not produce acidic effluent during kinetic testing, including 14-year column leach tests. Testing by MTMI, consultants, universities, and government agencies have examined and confirmed this behavior using a variety of kinetic and other test methods as described in Appendices 5 and 6 of Knight Piesold (2001).

In one study, acid-base account data obtained using MTMI's standard procedure was compared to data determined by other laboratories using a variety of acid-base accounting procedures. MTMI follows a standard procedure for acid-base accounting which uses a larger volume of acid leach solution with a lower acid concentration and less heating compared to the commonly used modified Sobek procedure. This method minimizes reaction with non-carbonate and non-neutralizing species and produces potentially understated values for neutralization potential compared to the modified Sobek procedure.

Comparison of acid-base account test results using the MTMI procedure with six different analytical laboratories using different methods is provided in Appendix 5 of Knight Piesold (2001). Acid production values were consistent between each of the methods. Five of the six laboratories reported neutralization potential values that were 8 to 23 tons CaCO3/kilotons of waste greater than the MTMI value of 14.5 tons CaCO3/kilotons (Table D4 in **Appendix D**).

Factors other than understated neutralization potential values predicted by the MTMI acid-base accounting procedure contribute to the behavior of MTMI samples during kinetic testing. Tailings samples, that also produced no acid during kinetic tests despite

high potential for acidification indicated by static test data, were investigated using a scanning electron microscope and energy dispersive analyses of x-rays. It was determined that the samples did not contain submicron grain sizes of pyrite that are easily weathered. Pyrite that was present was of a larger size and still able to generate acidity however at a fraction of the rate of submicron grains because much less reactive surface area is exposed per unit mass in the larger grained material (Knight Piesold 2001 and Dollhopf 1990).

A portion of the sulfur in MTMI samples that is reported as potential acidity in acid-base accounting procedures is associated with lead, zinc, and sulfate minerals other than pyrite that do not produce acid under oxidation conditions (Knight Piesold 2001).

In addition to carbonate minerals, mine rock contains alumino-silicate minerals that do not contribute to neutralizing potential in static tests. These minerals have slow reaction kinetics, however the large pyrite grains predominating the mine rock are also slow to react. Combined quantities of carbonate and alumino-silicate minerals in mine rock exceed the quantity of neutralization potential needed to balance acid potential (Knight Piesold 2001).

6.0 Open Pit highwall Characterization

Characterization of ore and waste rock discussed in earlier sections of this report is applicable to rock exposed in the pit highwall. In particular, 16-hour bottle roll test results are directly applicable because samples used for this test represented the 6 major rock types that make up the pit surfaces.

Average data for the bottle roll test, percentages of the aerial extent of each rock type in the pit highwall, and water quality data for the pit sump pond that forms at the bottom of the existing pit and from drawdown wells surrounding the mine pit are presented in Table D5 (**Appendix D**).

The average quality of pit pond water is typical of groundwater near the pit with additions from pit highwall leachate and contact with the higher sulfide mineralized diatreme of the pit floor. Pond water is neutral even though pit ponds always form in the core of the diatreme at the bottom of the mine where the highest sulfide mineralization occurs.

The different geologic units of the open pit highwalls have been exposed to weathering for many years since mine operations commenced. There is no evidence of iron staining on the walls, acid generation, or metals loading that have been identified.

7.0 References

Dollhopf, D.J. 1990. Assessment of Potential Acid Producing Characteristics of Tailings Material from Montana Tunnels Mining. Montana State University Reclamation Research Unit.

Knight Piesold Ltd. 2001. Apollo Gold Corporation Montana Tunnels Mine Open Pit Flooding and Water Quality Modeling.

MTMI. 2005. Second Deficiency Responses Enviromin Comments 11-2-2005 Rev. 1 Responses. November 2, 2005.

Sillitoe, R.H., G.L. Grauberger, and J.E. Elliott. 1985. "A Diatreme-Hosted Gold Deposit at Montana Tunnels, Montana". Economic Geology. Volume 80. Pages 1707-1721.

Statistical Package for Social Science, Inc. 1997. SPSS Inc. 1997. SigmaStat for Windows Version 2.03.

U. S. Department of the Interior, Bureau of Land Management (BLM). 1996. Memorandum from BLM Director. Acid Rock Drainage Policy for Activities Authorized under 43 CFR 3802/3809. Instruction Memorandum No. 96-97. April 2, 1996.

Appendix A

Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

TABLE A1
Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

Rock Type	Data Type	Test Method	No. of samples	Purpose or Other Notes	Reference
Elkhorn Volcanics	Metal Mobility	16 Hour Bottle Roll	1	Contribution of rainwater contact with pit highwall in pit lake model chemistry (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	1	This sample is a split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall (Appendix A2).	1
	Whole Rock	HCL, HNO_3, HF digestion	2	Characterization of pit rock types (Appendix A3).	1
	Acid Base Account	ABA in accordance with MTMI SOP	3	Splits of samples used for bottle roll (Appendix 1) and whole rock testing (Appendix A3).	1
Elkhorn Volcanics With Diatreme Breccia	Whole Rock	HCL, HNO_3, HF digestion	1	Characterization of pit rock types (Appendix A3).	1
	Acid Base Account	ABA in accordance with MTMI SOP	1	Split of sample used for whole rock testing (Appendix A3).	1
Lowland Creek Volcanics	Metal Mobility	16 Hour Bottle Roll	1	Contribution of rainwater contact with pit highwall in pit lake model chemistry (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	1	This sample is a split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall (Appendix A2).	1
	Whole Rock	HCL, HNO_3, HF digestion	3	Characterization of pit rock types (Appendix A3).	1
	Acid Base Account	ABA in accordance with MTMI SOP	4	Splits of samples used for bottle roll (Appendix 1) and whole rock testing (Appendix A3).	1
Lowland Creek Volcanics with Biotite Dike	Whole Rock	HCL, HNO_3, HF digestion	2	Characterization of pit rock types (Appendix A3).	1
	Acid Base Account	ABA in accordance with MTMI SOP	2	Splits of samples used for whole rock testing (Appendix A3).	1
Lowland Creek	Whole Rock	HCL, HNO_3, HF digestion	3	Characterization of pit rock types (Appendix A3).	1

TABLE A1
Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

Rock Type	Data Type	Test Method	No. of samples	Purpose or Other Notes	Reference
Volcanics with Diatreme Breccia	Acid Base Account	ABA in accordance with MTMI SOP	3	Splits of samples used for whole rock testing (Appendix A3).	1
Biotite Dike	Metal Mobility	16 Hour Bottle Roll	1	Contribution of rainwater contact with pit highwall in pit lake model chemistry (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	1	This sample is a split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall (Appendix A2).	1
	Acid Base Account	ABA in accordance with MTMI SOP	1	Split of sample used for bottle roll testing (Appendix 1).	1
Diatreme Waste	Metal Mobility	16 Hour Bottle Roll	3	Contribution of rainwater contact with pit highwall in pit lake model chemistry. Includes samples labeled; Diatreme Waste South, Diatreme Waste North, and Diatreme Waste Dump #6 (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	3	Split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall. Includes samples labeled; Diatreme Waste South, Diatreme Waste North, and Diatreme Waste Dump #6 (Appendix A2).	1
		Long-term column leach	2	Leachate from long-term column tests analyzed for metals 5 times between 2000 and 2005 (columns 2&3 are waste).	2
	Whole Rock	Unknown	2	4 or 5 analyses performed on samples repeatedly collected during MTMI long-term in-house column tests (columns 2&3 are waste).	2
	Acid Base Account	ABA in accordance with MTMI SOP	2	5 or 6 analyses performed on samples repeatedly collected during long term column testing (columns 2&3 are waste).	2
	Acid Base Account	ABA in accordance with MTMI SOP	3	Split of sample used for bottle roll testing. Includes samples labeled; Diatreme Waste South, Diatreme Waste North, and Diatreme Waste Dump #6 (Appendix 1).	1
	Kinetic Test	Long-term column leach	2	In house, long-term leaching to determine ARD behavior. From 1991 through 2005 (columns 2&3 are waste).	2

TABLE A1
Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

Rock Type	Data Type	Test Method	No. of samples	Purpose or Other Notes	Reference
Diatreme Breccia with Quartz Latite Dike	Whole Rock	HCL, HNO_3, HF digestion	2	Characterization of pit rock types (Appendix A3).	1
	Acid Base Account	ABA in accordance with MTMI SOP	2	Splits of samples used for whole rock testing (Appendix A3).	1
Unspecified Diatreme	Whole Rock	HCL, HNO_3, HF digestion	19	Characterization of pit rock types (Appendix A3). These samples are labeled "Diatreme Breccia." Some may represent ore.	1
	Acid Base Account	ABA in accordance with MTMI SOP	19	Characterization of pit rock types (Appendix A3). These samples are labeled "Diatreme Breccia." Some may represent ore.	1
Quartz Latite Dike	Metal Mobility	16 Hour Bottle Roll	1	Contribution of rainwater contact with pit highwall in pit lake model chemistry (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	1	This sample is a split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall (Appendix A2).	1
	Acid Base Account	ABA in accordance with MTMI SOP	1	Split of sample used for bottle roll testing (Appendix 1).	1
Diatreme Ore	Whole Rock	HCL, HNO_3, HF digestion	At least 4	Characterization of pit rock types (Appendix A3). Only 4 samples were specified as "high grade" or "ore." Other ore samples may be reported below as "Unspecified Diatreme."	1
		Unknown	4	4 or 5 analyses performed on samples repeatedly collected during long-term in-house column tests (columns 1, 4, 5, & 6 are ore).	2
	Metal Mobility	16 Hour Bottle Roll	1	Contribution of rainwater contact with pit highwall in pit lake model chemistry (Appendix A1).	1
		7, 15, and 30 day soak with tailings reclaim water	1	This sample is a split of that used in the 16 hour bottle roll test and was used to characterize the long-term affect of TSF water in contact with the pit highwall (Appendix A2).	1
		Long-term column leach testing	4	5 (2000 to 2005) analyses performed on samples collected during long-term in-house column tests (columns 1, 4, 5, & 6 are ore)..	2

TABLE A1
Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

Rock Type	Data Type	Test Method	No. of samples	Purpose or Other Notes	Reference
Diatreme Ore (Cont.)	Acid Base Account	ABA in accordance with MTMI SOP	1	Split of sample used for bottle roll testing (Appendix 1).	1
		ABA in accordance with MTMI SOP	At least 4	Splits of sample used for whole rock testing (Appendix A3).	1
		Sobek	3	Three samples labeled “shot…” for ARD prediction, assumed to be ore (Ziemkiewicz and Renton. 1992) (Appendix A5).	1
		ABA in accordance with MTMI SOP	4	5 or 6 analyses performed on samples repeatedly collected during long-term in-house column tests (columns 1, 4, 5, & 6 are ore).	2
	Kinetic Test	Soxhlet / oven bake cycles	3	Splits of samples used for Sobek procedure (Ziemkiewicz and Renton. 1992) (Appendix A5).	1
		Long-term column leach	4	Long-term in-house column tests (columns 1, 4,5, & 6 are ore).	2
Unspecified Rock Types	Acid Base Account	ABA in accordance with MTMI SOP	2	Two rock samples from pit were analyzed for ABA, but not characterized as specific rock type (Appendix A3).	1
		ABA in accordance with MTMI SOP	Approx. 1900	Blast grid composites for annual monitoring reports (From 1989 to present) on various rock samples. Likely to include some samples listed elsewhere in this table. Six samples represent expansion material.	3
		Sobek	2	Two samples labeled “waste rock” and “low-grade stockpile” for ARD prediction (Ziemkiewicz and Renton. 1992) (Appendix A5).	1
	Kinetic Test	6 different procedures	6 splits of 1 bulk sample	Evaluation of ARD predictive tests (Lapakko 1992) (sulfide mineral low-grade ore) (Appendix A5). Leachate metals data collected from Soxhlet, modified Humidity cell, and “Wet-Dry” tests.	1
		Soxhlet / oven bake cycles	2	Splits of samples used for Sobek ABA procedure (Ziemkiewicz and Renton. 1992) (Appendix A5).	1

TABLE A1
Summary of Available Montana Tunnels Geochemistry Data For M-Pit Mine Expansion

Rock Type	Data Type	Test Method	No. of samples	Purpose or Other Notes	Reference
Tailings	Acid Base Account	Sobek	3	Three samples labeled "Tailings…" for ARD prediction (Ziemkiewicz and Renton. 1992) (Appendix A5).	1
		Unreported ABA	3	Tailings sand, midlings, and slimes for ARD prediction, split for ABA and Kinetic test (Dollhopf. 1990) (Appendix A5).	1
		ABA in accordance with MTMI SOP	58	ABA analyses performed for annual monitoring reports (From 1989 to present) on various rock samples.	3
	Kinetic Test	Soxhlet / oven bake cycles	3	Splits of samples used for Sobek procedure (Ziemkiewicz and Renton. 1992) (Appendix A5).	1
		Repeated soaking, agitation, and drying cycles	3	Tailings sand, midlings, and slimes for ARD prediction, split for ABA and Kinetic test (Dollhopf. 1990) (Appendix A5).	1
	Kinetic Test	modified column leach	1	4 extractions from 25-pound, +200 mesh dewatered tailings sample for pore water evaluation (Appendix A4).	
	Water Quality	Analyses for various parameters	many	Samples from TSF supernatant, underdrains, embankment drains, and groundwater wells (1993 to 1999) (Appendix B).	1

[1] Knight Piesold Ltd. 2001. Apollo Gold Corporation Montana Tunnels Mine Open Pit Flooding and Water Quality Modeling.
[2] COLUMNS~1-6.xls
[3] ABA to Date.xls

Appendix B

One-Way Analysis of Variance Table

One Way Analysis of Variance   Thursday, December 22, 2005, 13:33:30

Data source: MT Tunnels NPAP in Notebook

Normality Test: Failed (P = <0.001)
Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks   Thursday, December 22, 2005, 13:33:30

Data source: MT Tunnels NPAP in Notebook

Group	N	Missing	Median	25%	75%
NP:AP 4100 to 4600	6	0	0.725	0.640	1.020
NP:AP 4600 to 5100	195	0	0.630	0.390	0.950
NP:AP 5100 to 5600	901	0	1.720	1.070	3.192
NP:AP 5600 to 6100	750	0	2.690	1.560	4.700
NP:AP 6100+	23	0	60.830	18.470	111.503

H = 408.752 with 4 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
NP:AP 6100+ vs NP:AP 4600 to 5100	1486.642	12.455	Yes
NP:AP 6100+ vs NP:AP 4100 to 4600	1348.359	5.433	Yes
NP:AP 6100+ vs NP:AP 5100 to 5600	882.052	7.715	Yes
NP:AP 6100+ vs NP:AP 5600 to 6100	679.569	5.929	Yes
NP:AP 5600 to 6100 vs NP:AP 4600 to 5100	807.073	18.545	Yes
NP:AP 5600 to 6100 vs NP:AP 4100 to 4600	668.789	3.014	Yes
NP:AP 5600 to 6100 vs NP:AP 5100 to 5600	202.483	7.566	Yes
NP:AP 5100 to 5600 vs NP:AP 4600 to 5100	604.590	14.139	Yes
NP:AP 5100 to 5600 vs NP:AP 4100 to 4600	466.307	2.103	No
NP:AP 4100 to 4600 vs NP:AP 4600 to 5100	138.283	0.616	No

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Appendix C

Plots of Kinetic Test Data

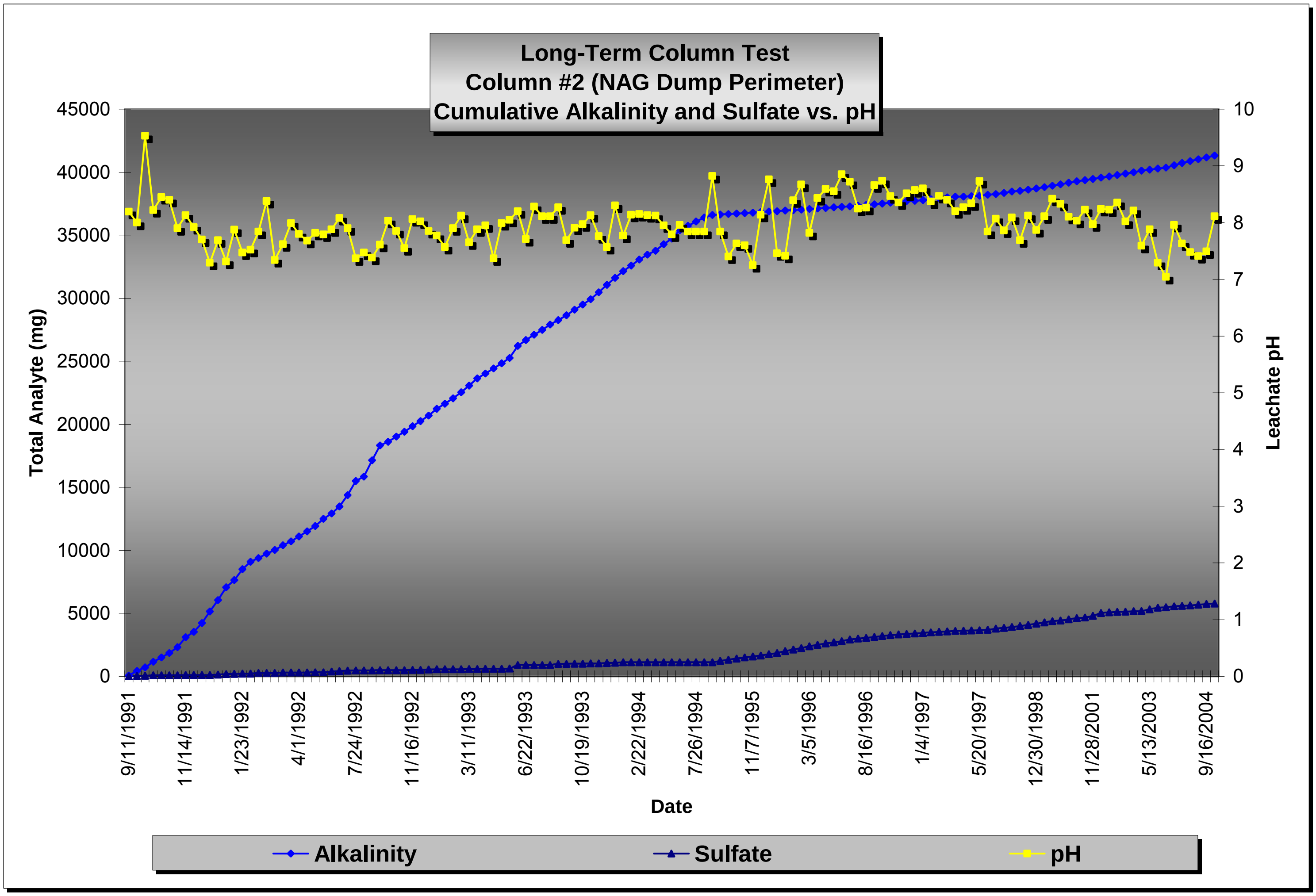


Figure C1. Long term column leach test data.

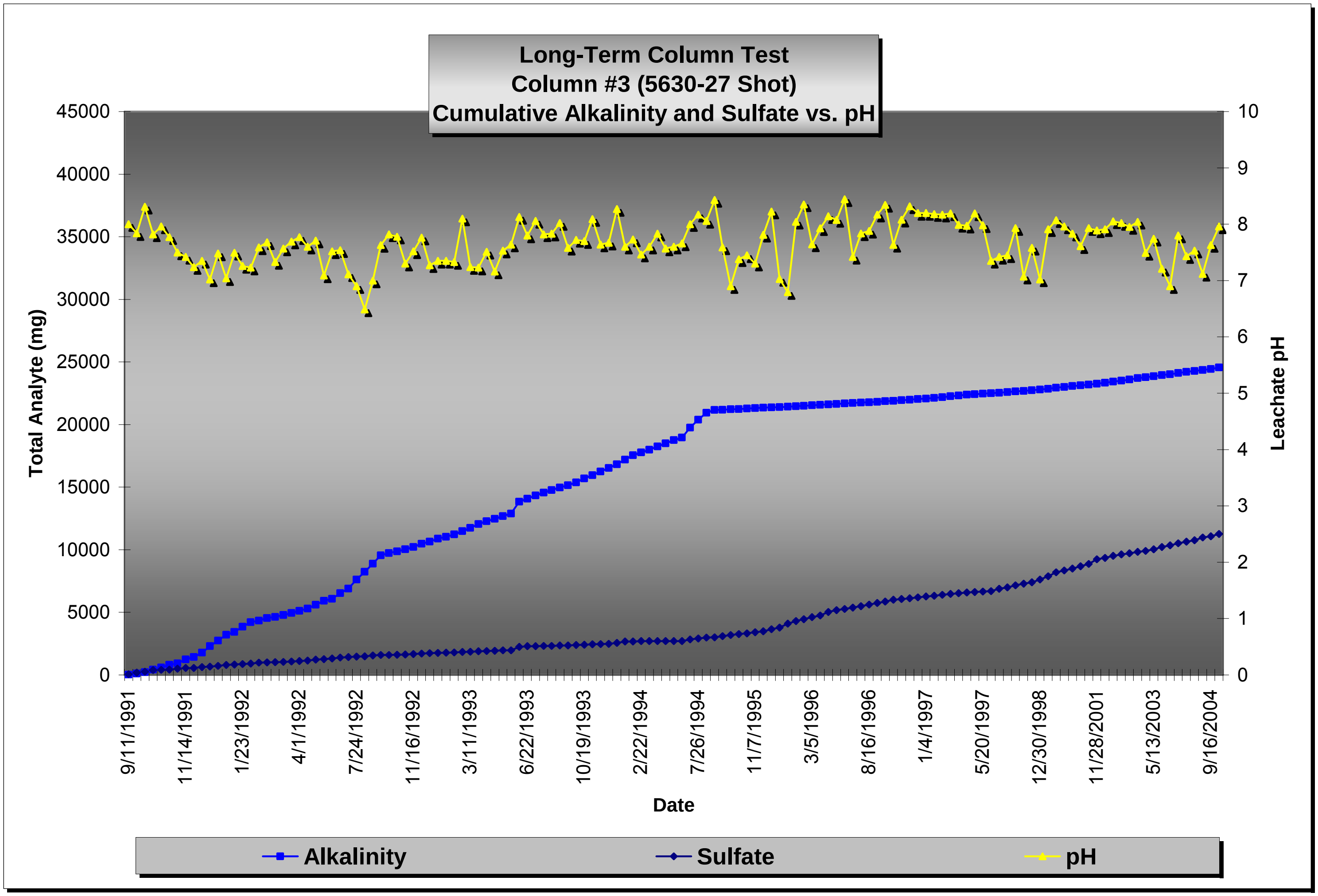


Figure C2. Long term column leach test data.

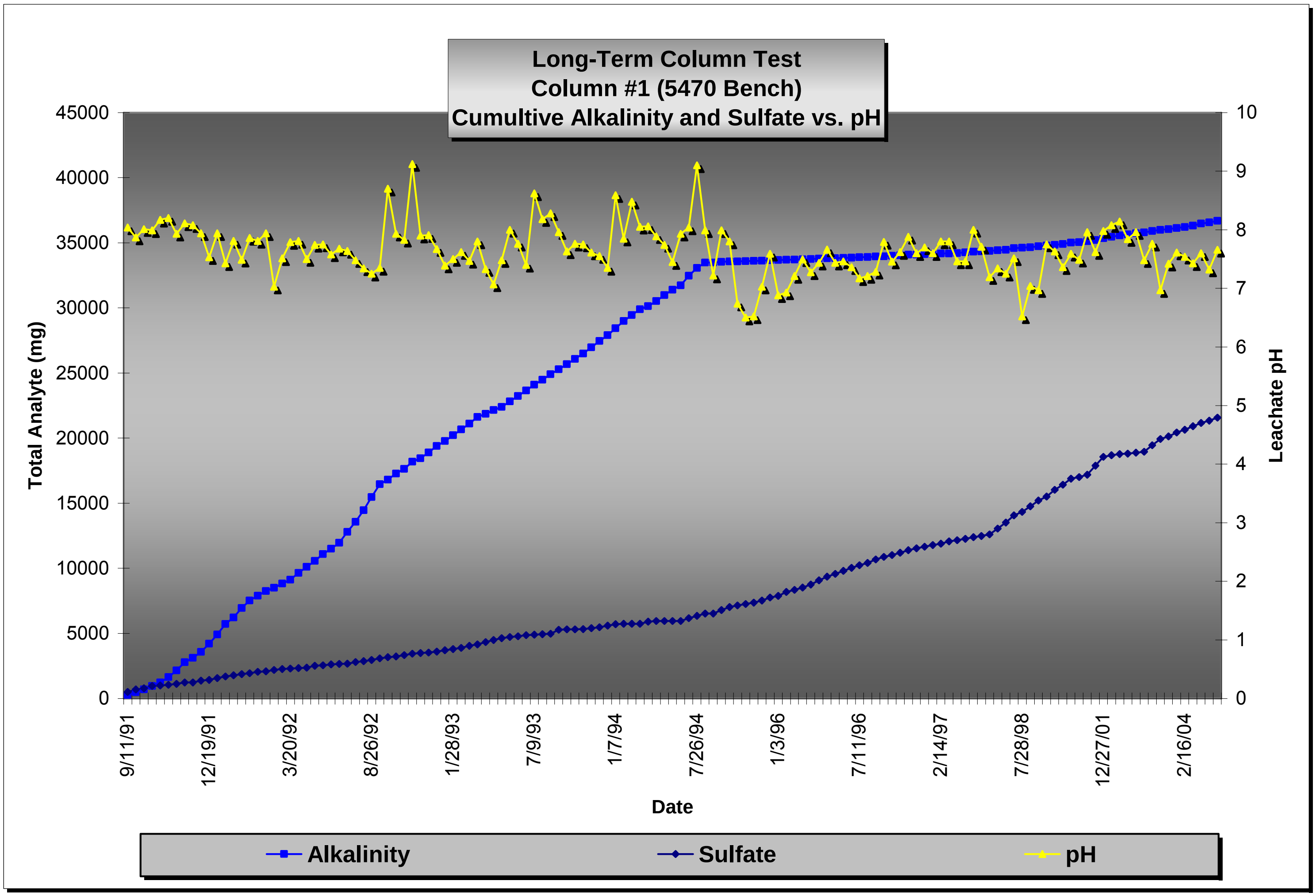


Figure C3. Long term column leach test data.

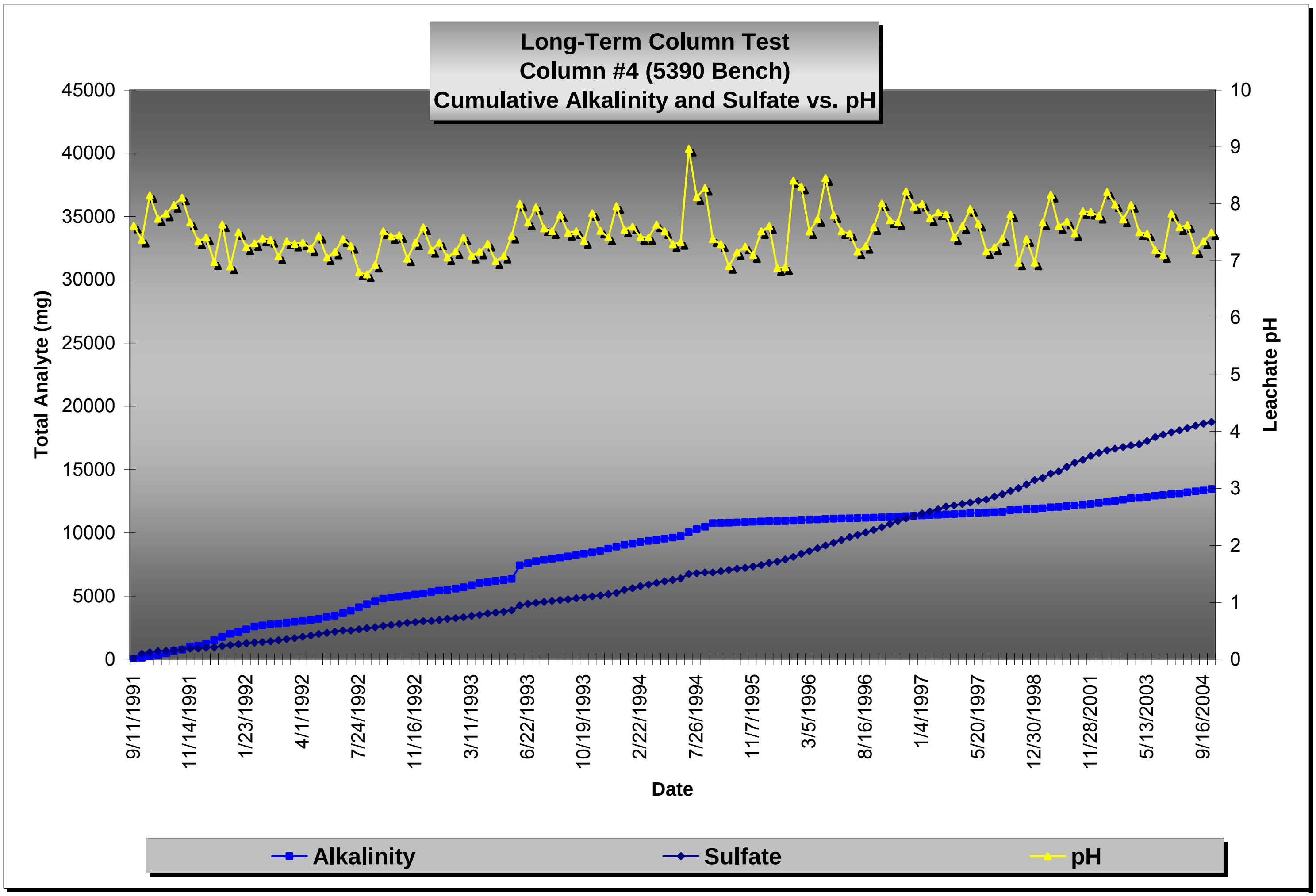


Figure C4. Long term column leach test data.

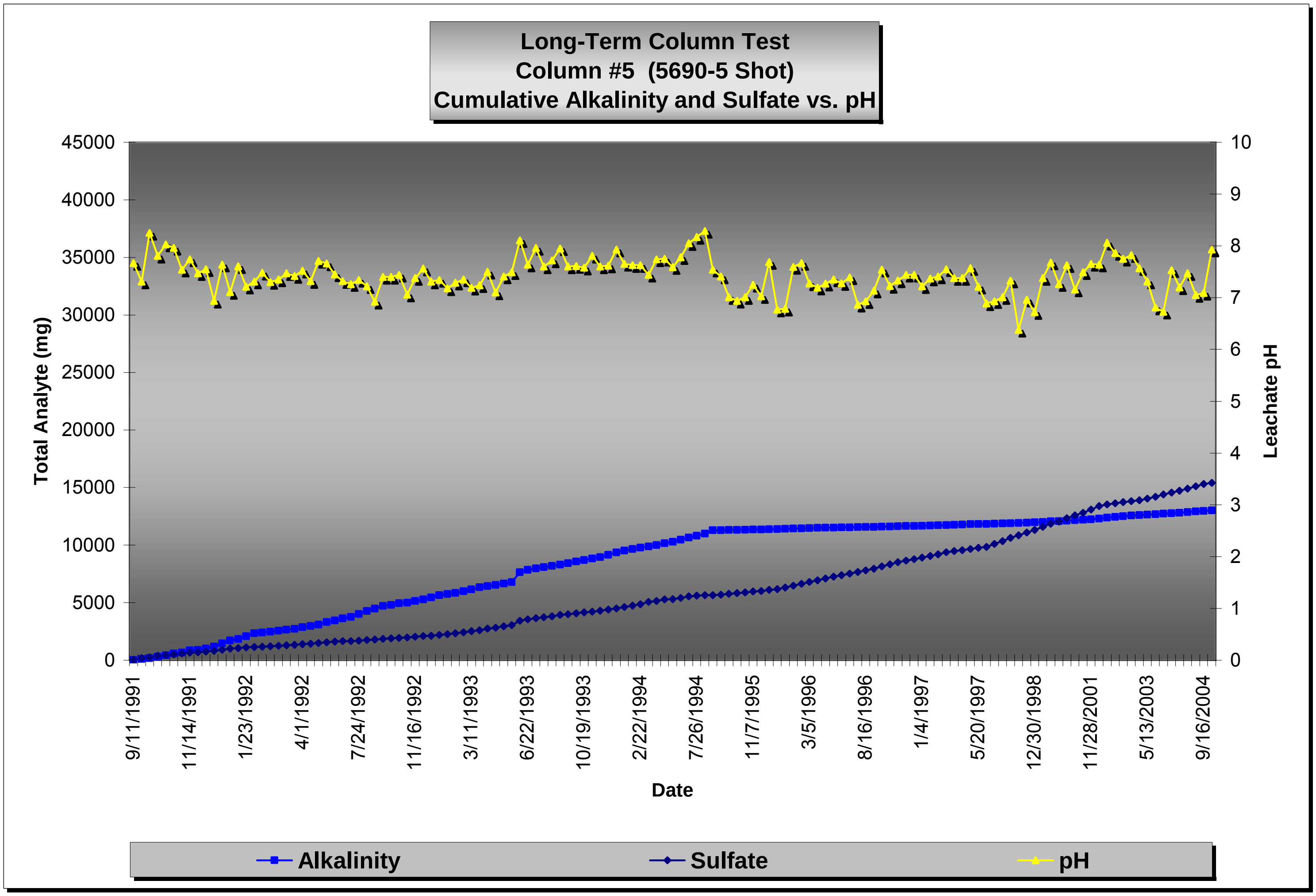


Figure C5. Long term column leach test data.

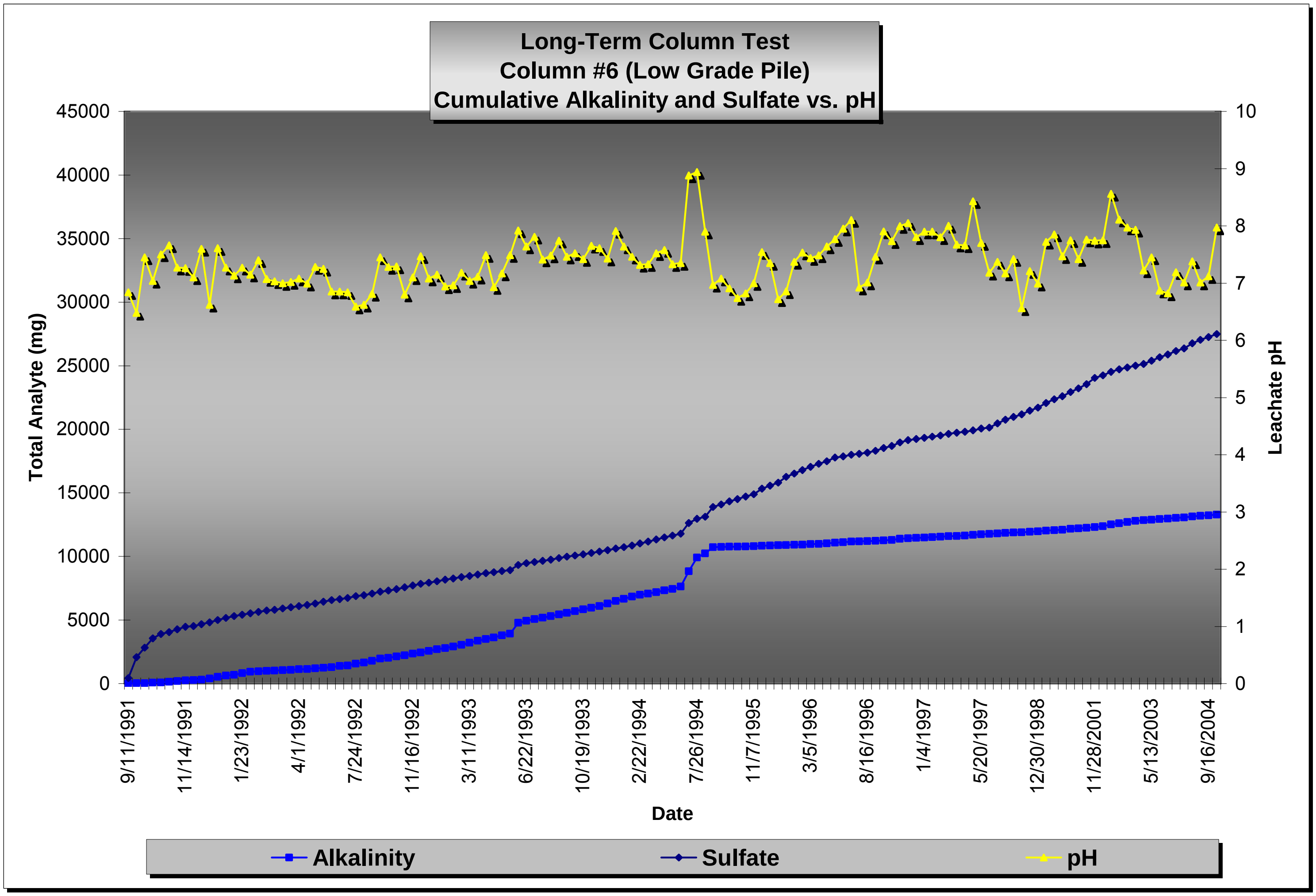


Figure C6. Long term column leach test data.

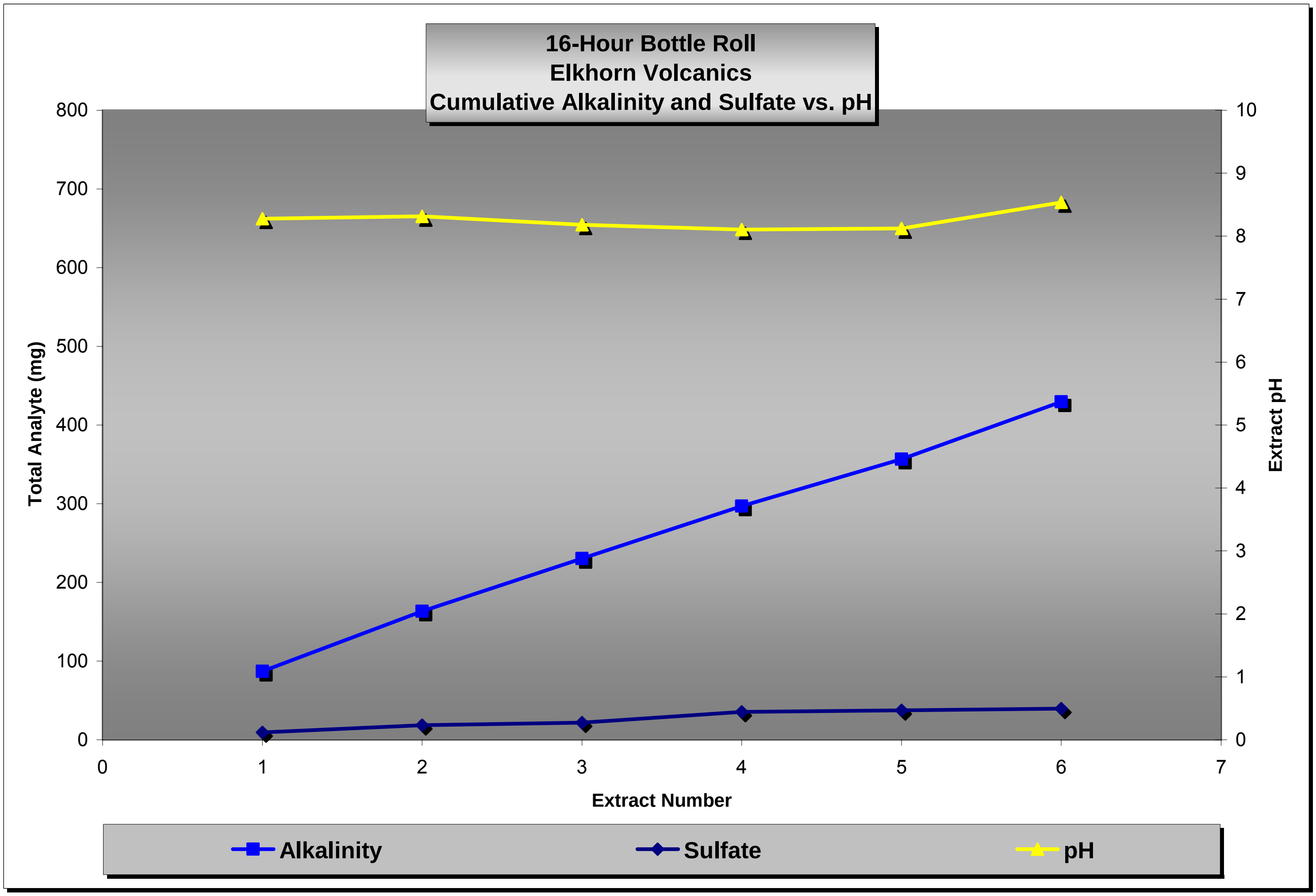


Figure C7. 16-hour bottle roll test data.

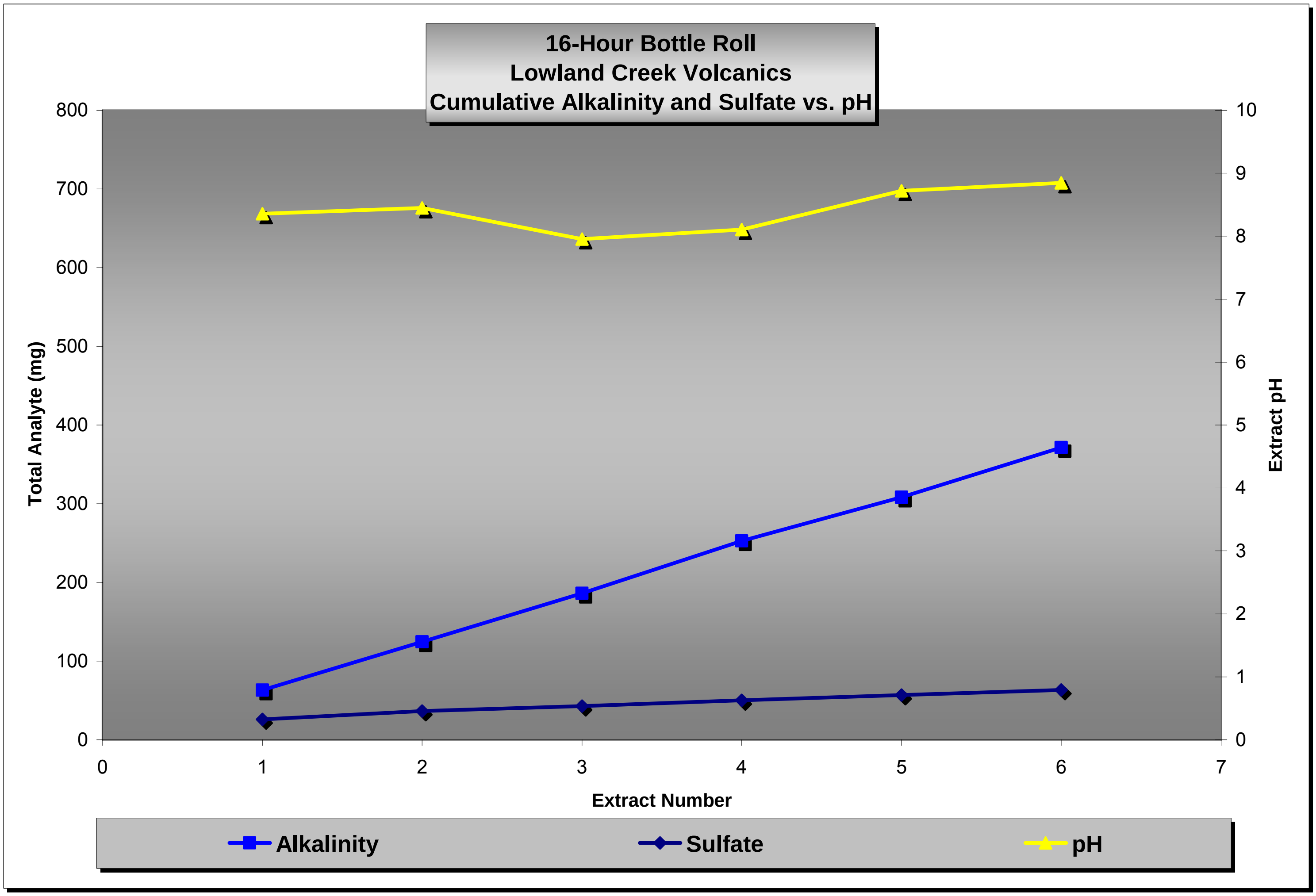


Figure C8. 16-hour bottle roll test data.

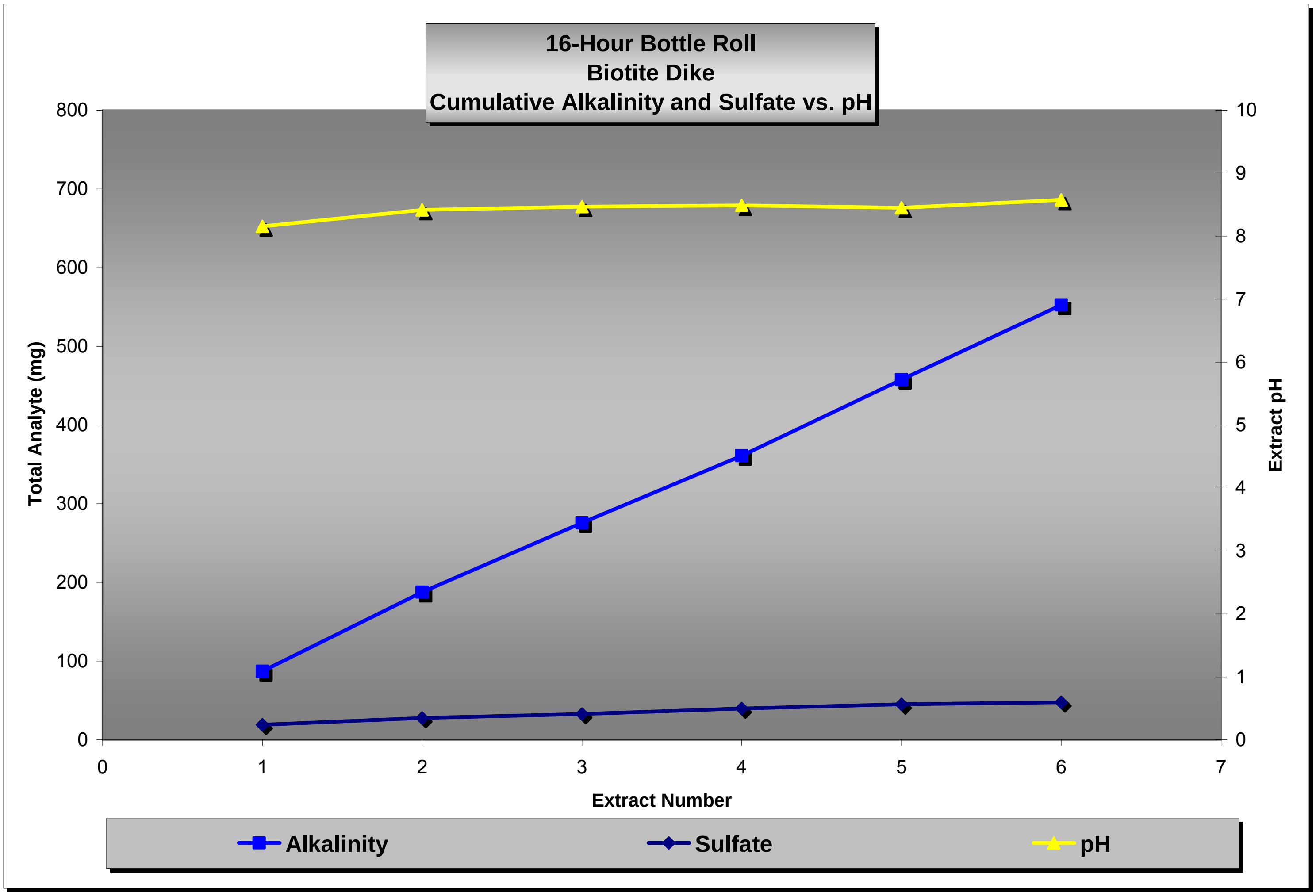


Figure C9. 16-hour bottle roll test data.

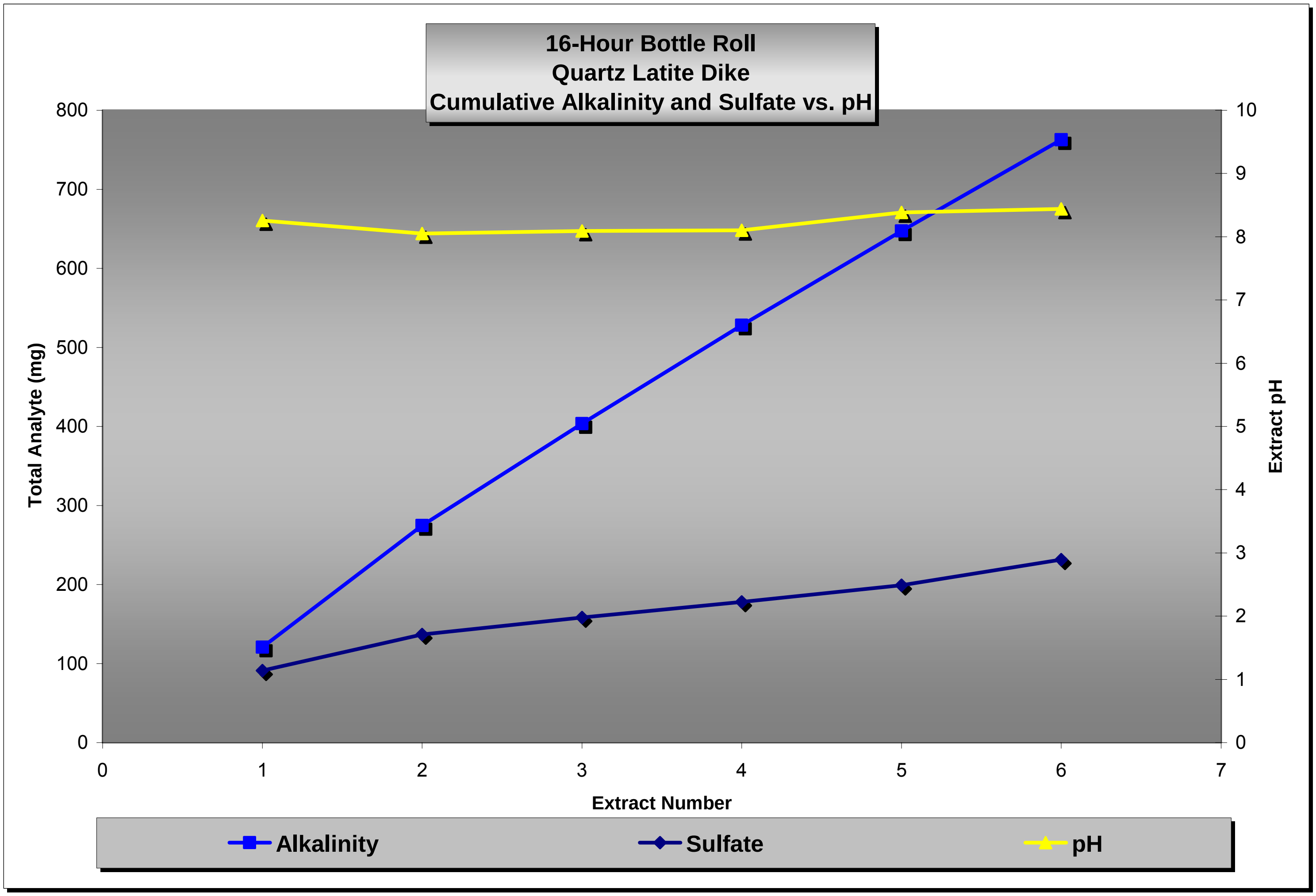


Figure C10. 16-hour bottle roll test data.

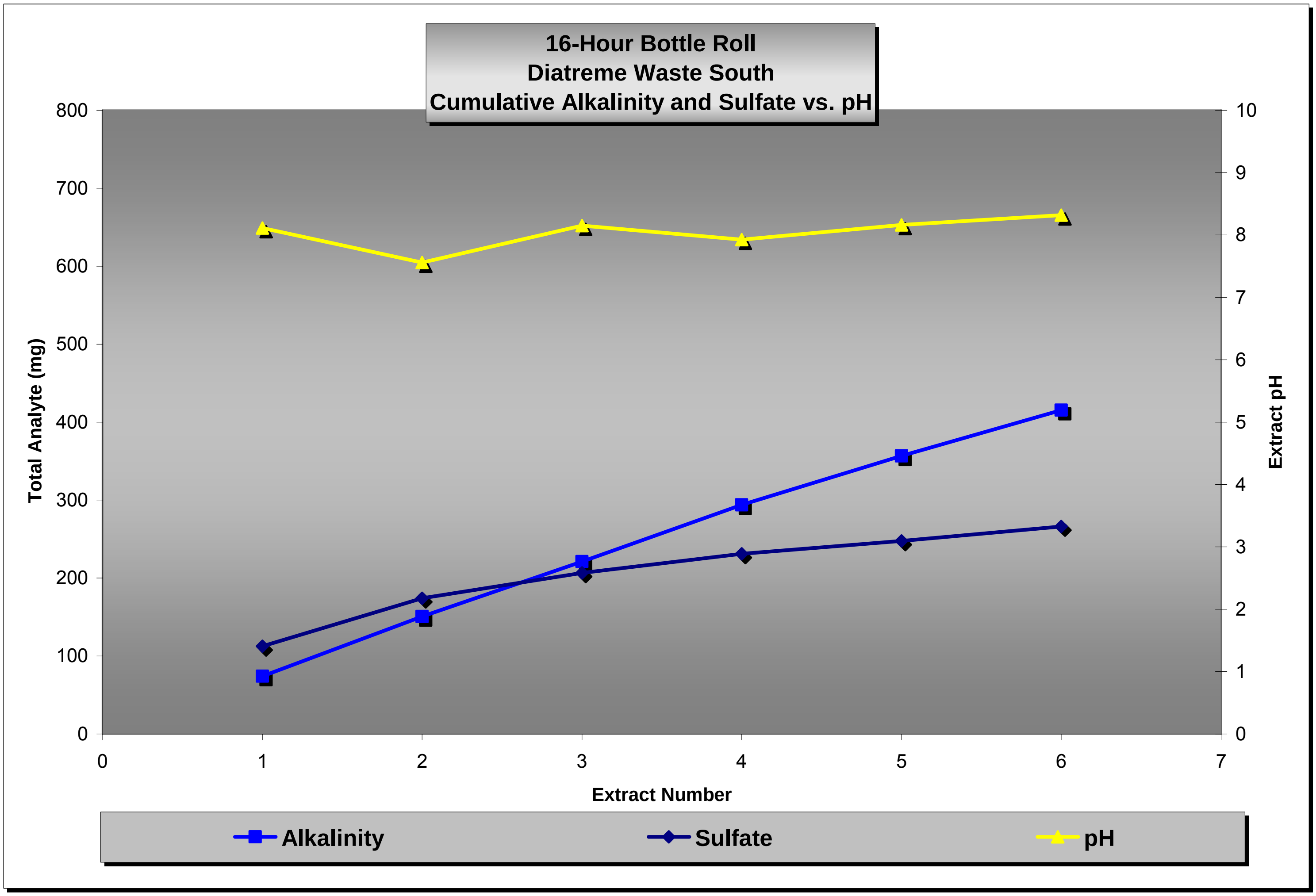


Figure C11. 16-hour bottle roll test data.

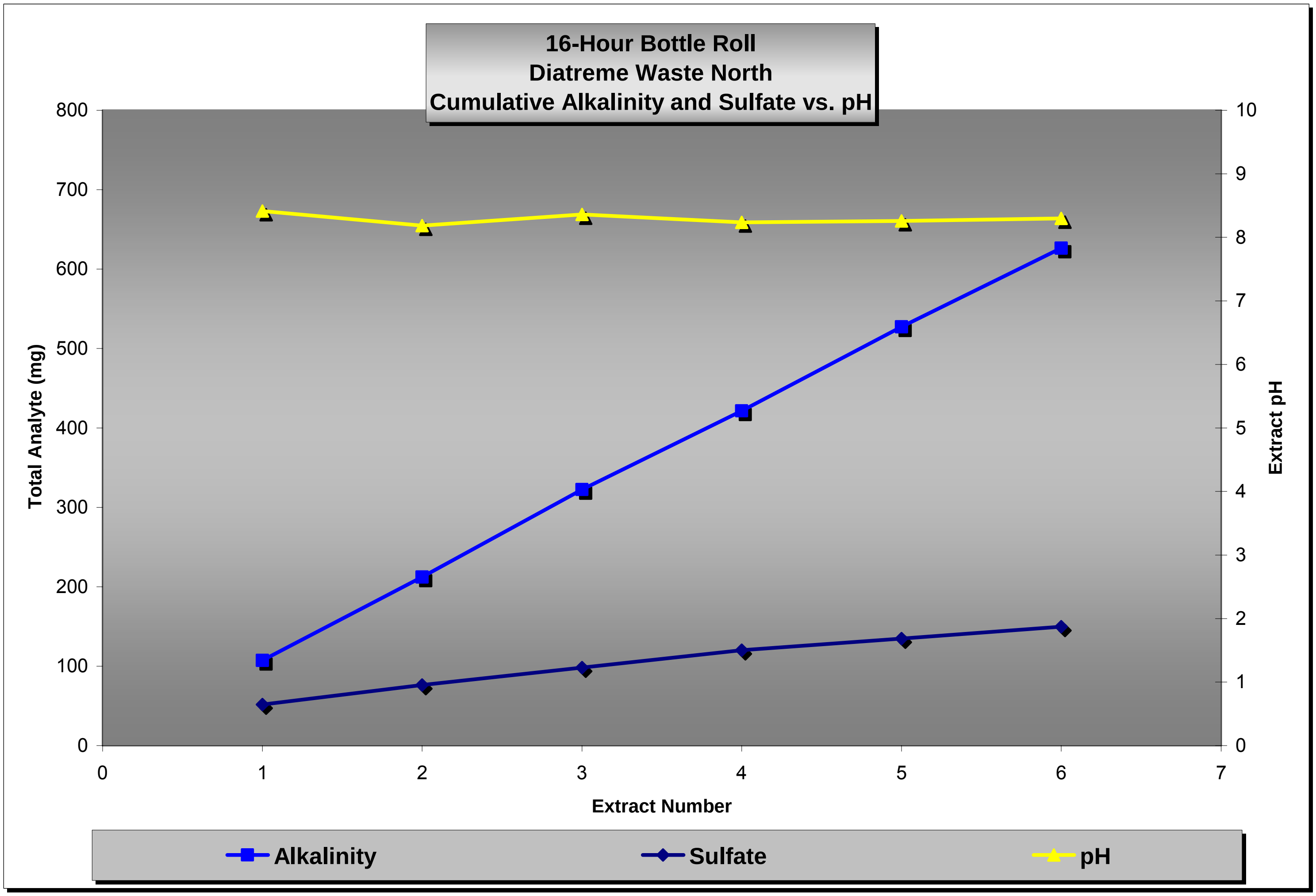


Figure C12. 16-hour bottle roll test data.

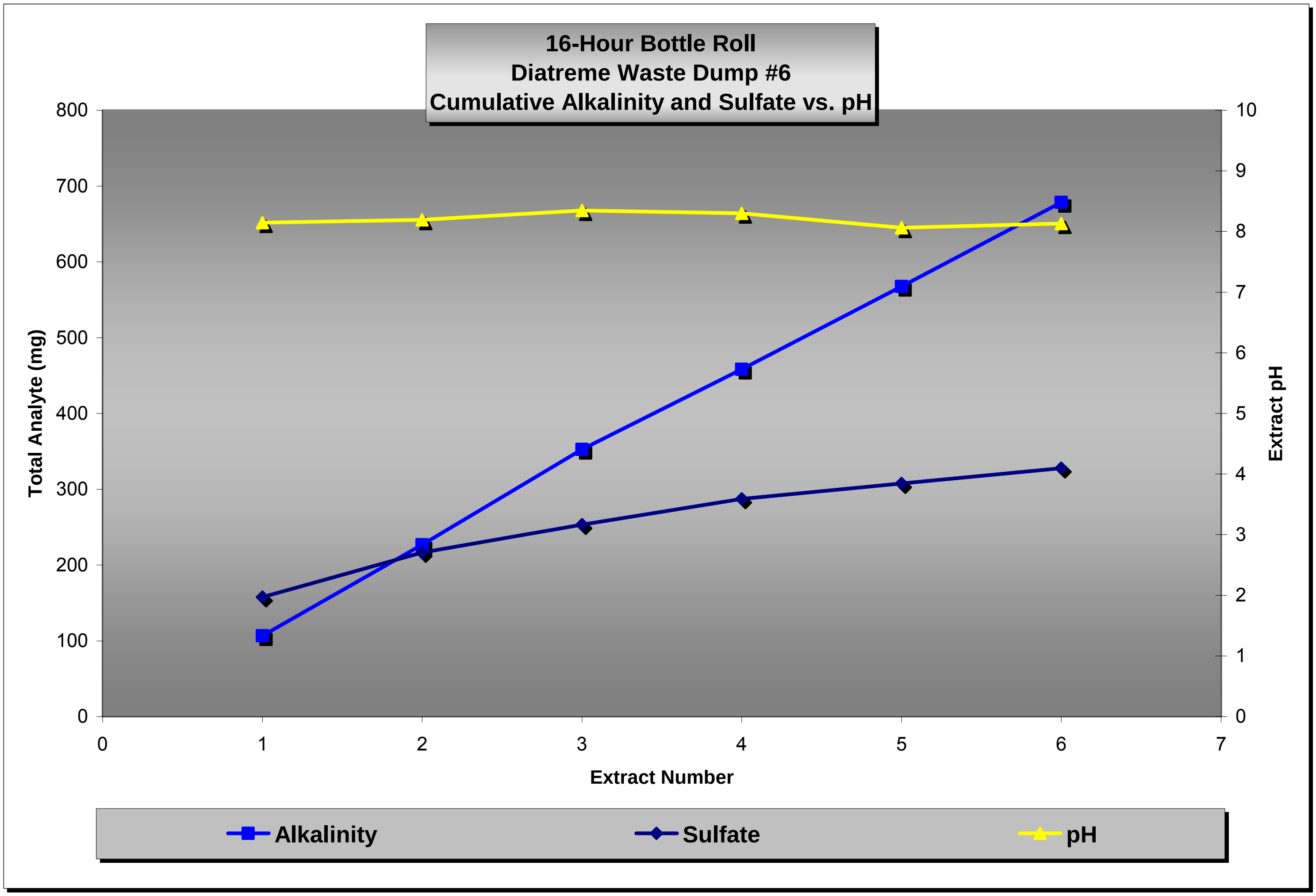


Figure C13. 16-hour bottle roll test data.

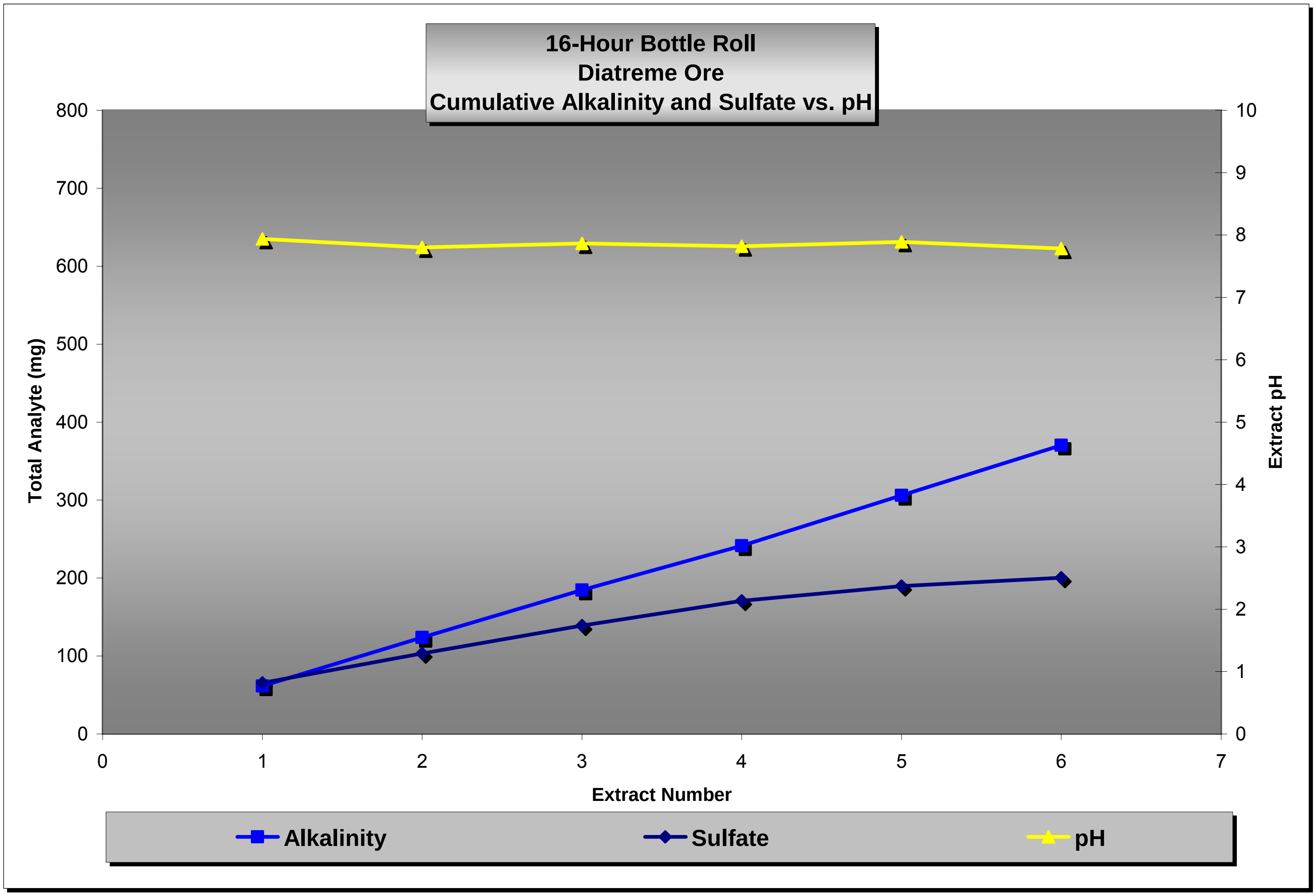


Figure C14. 16-hour bottle roll test data.

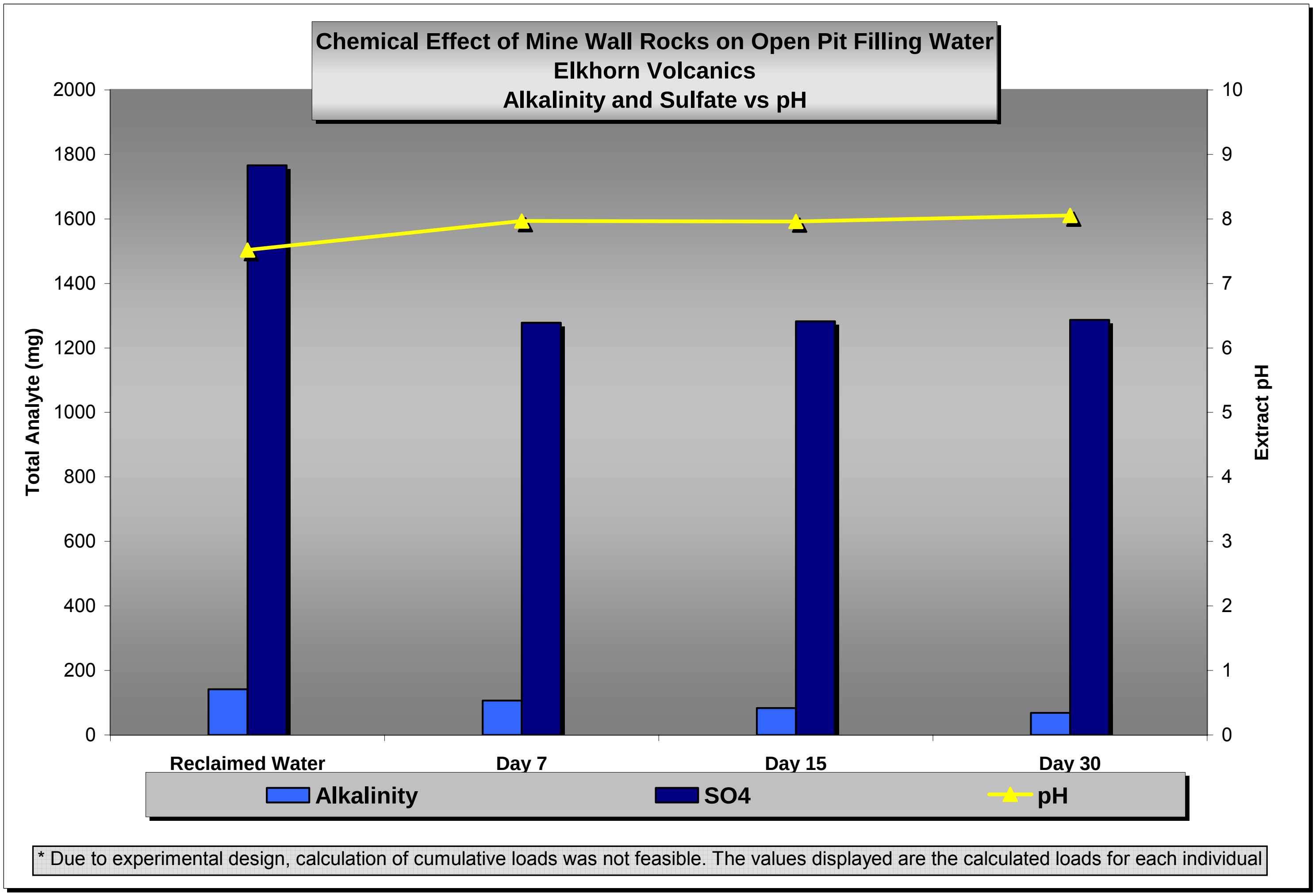


Figure C15. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

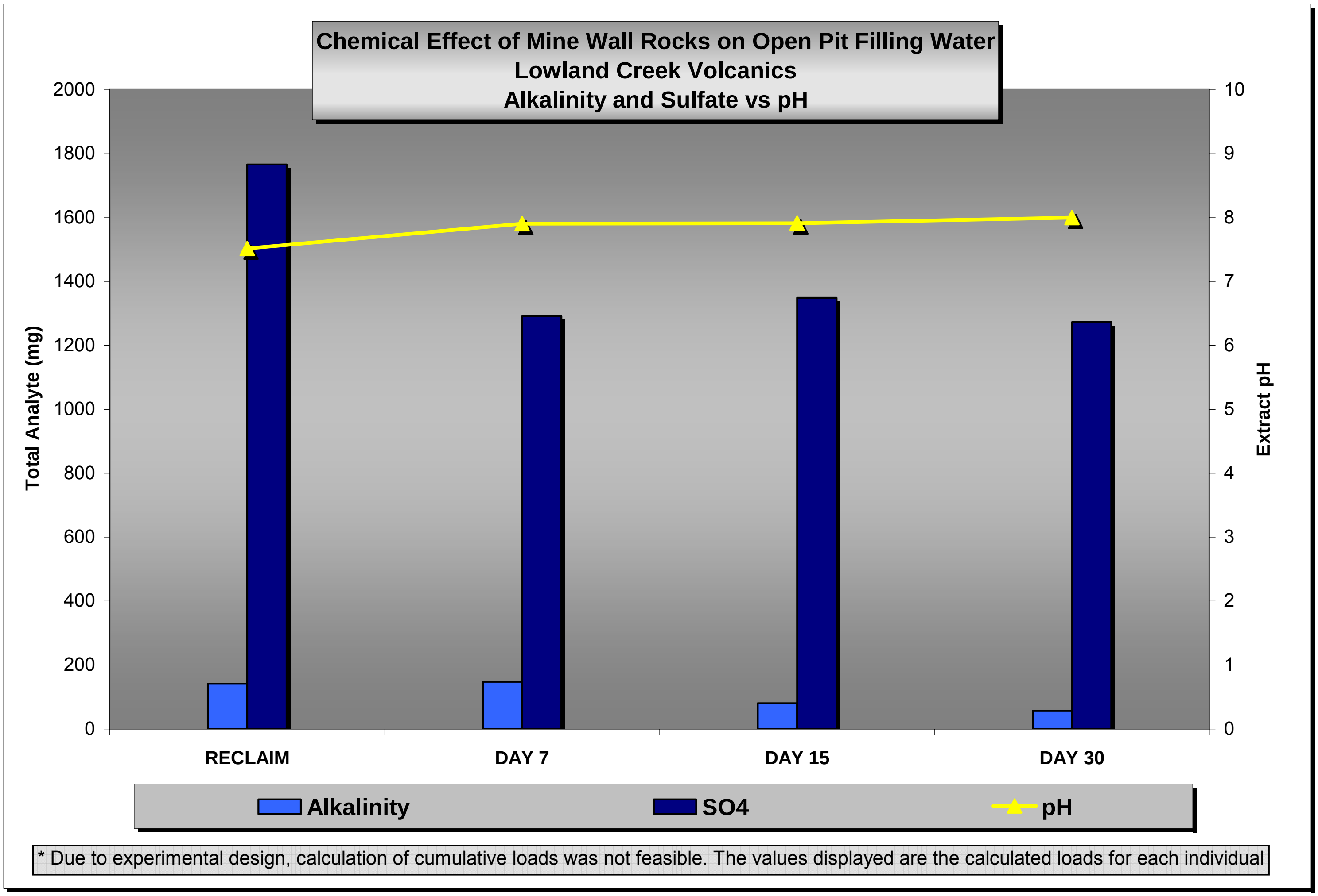


Figure C16. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

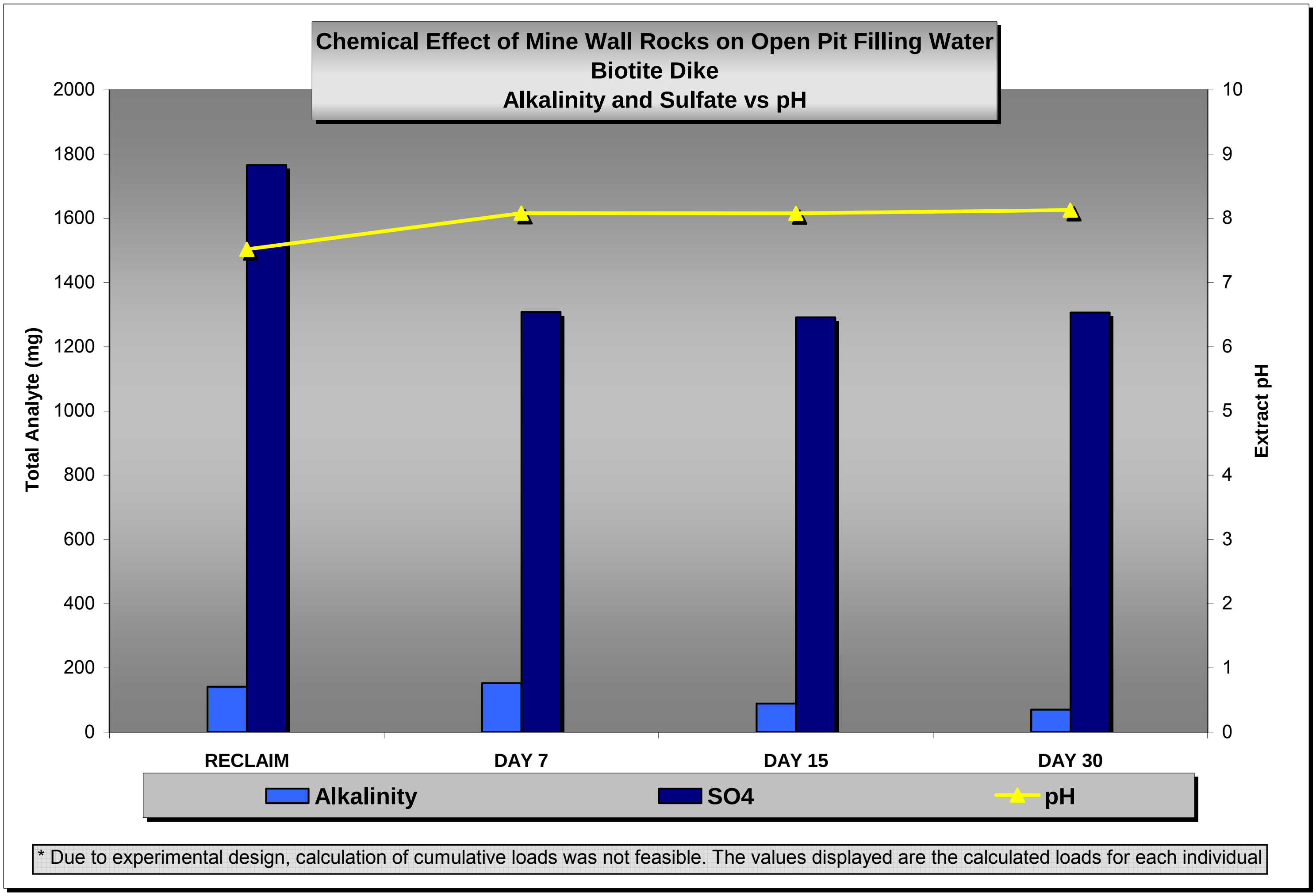


Figure C17. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

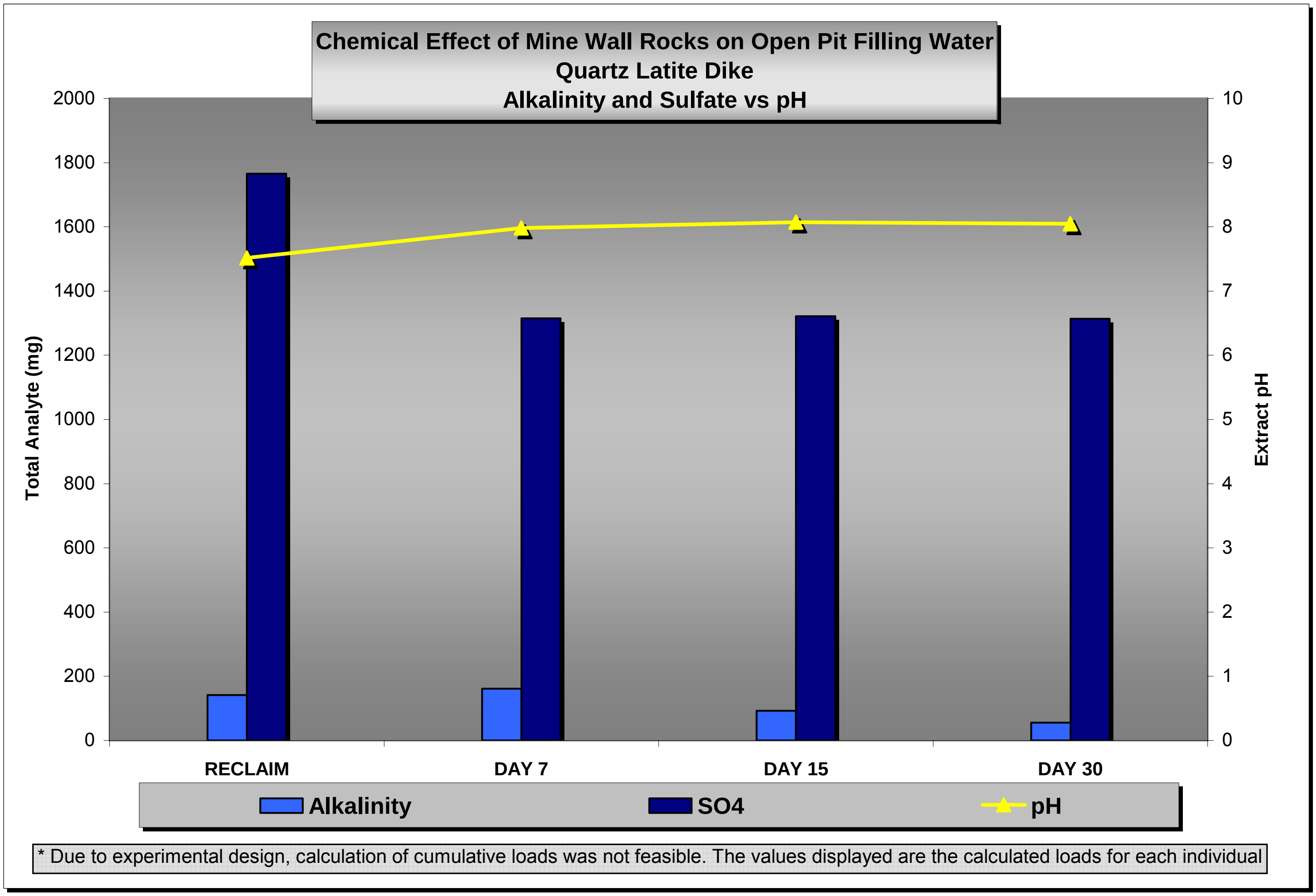


Figure C18. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

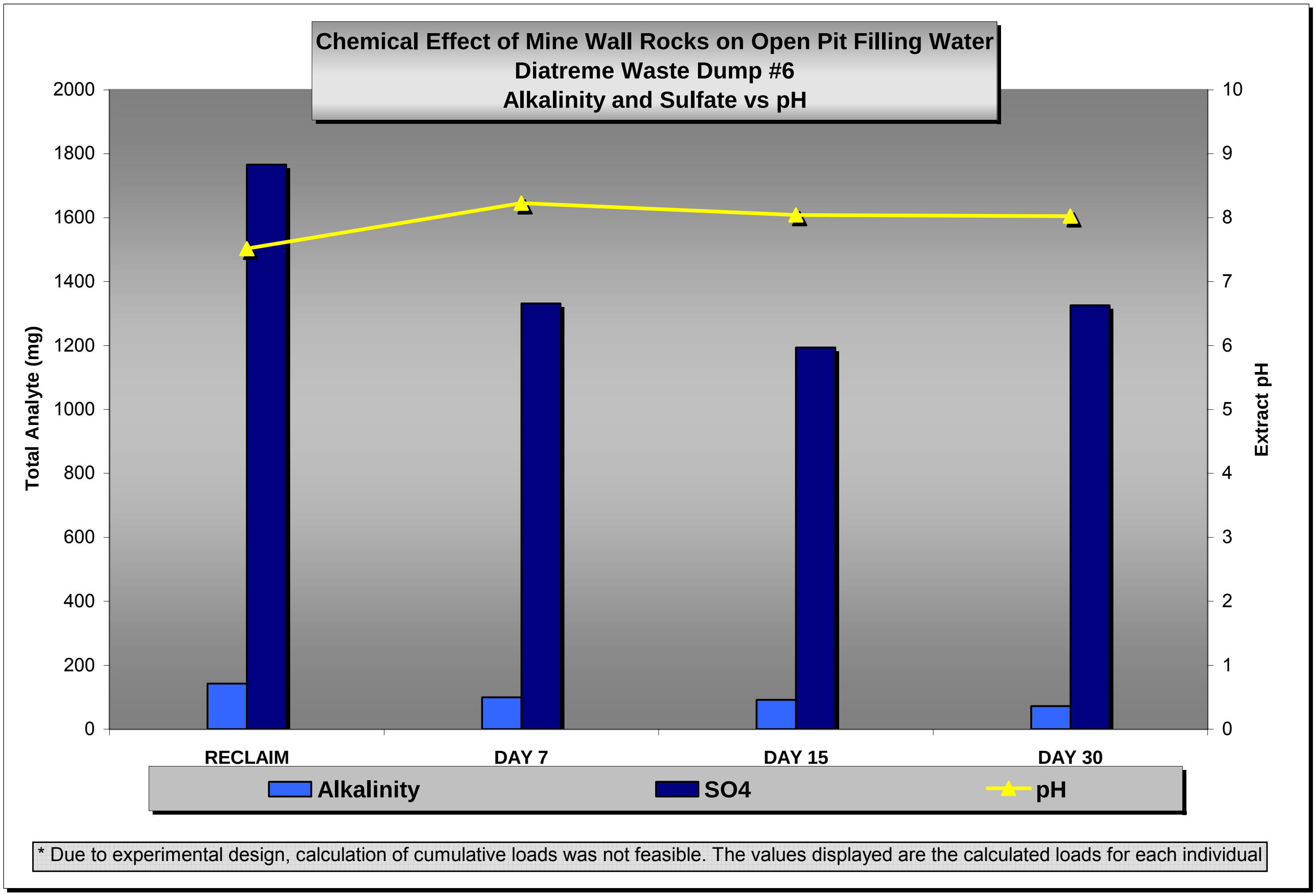


Figure C19. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

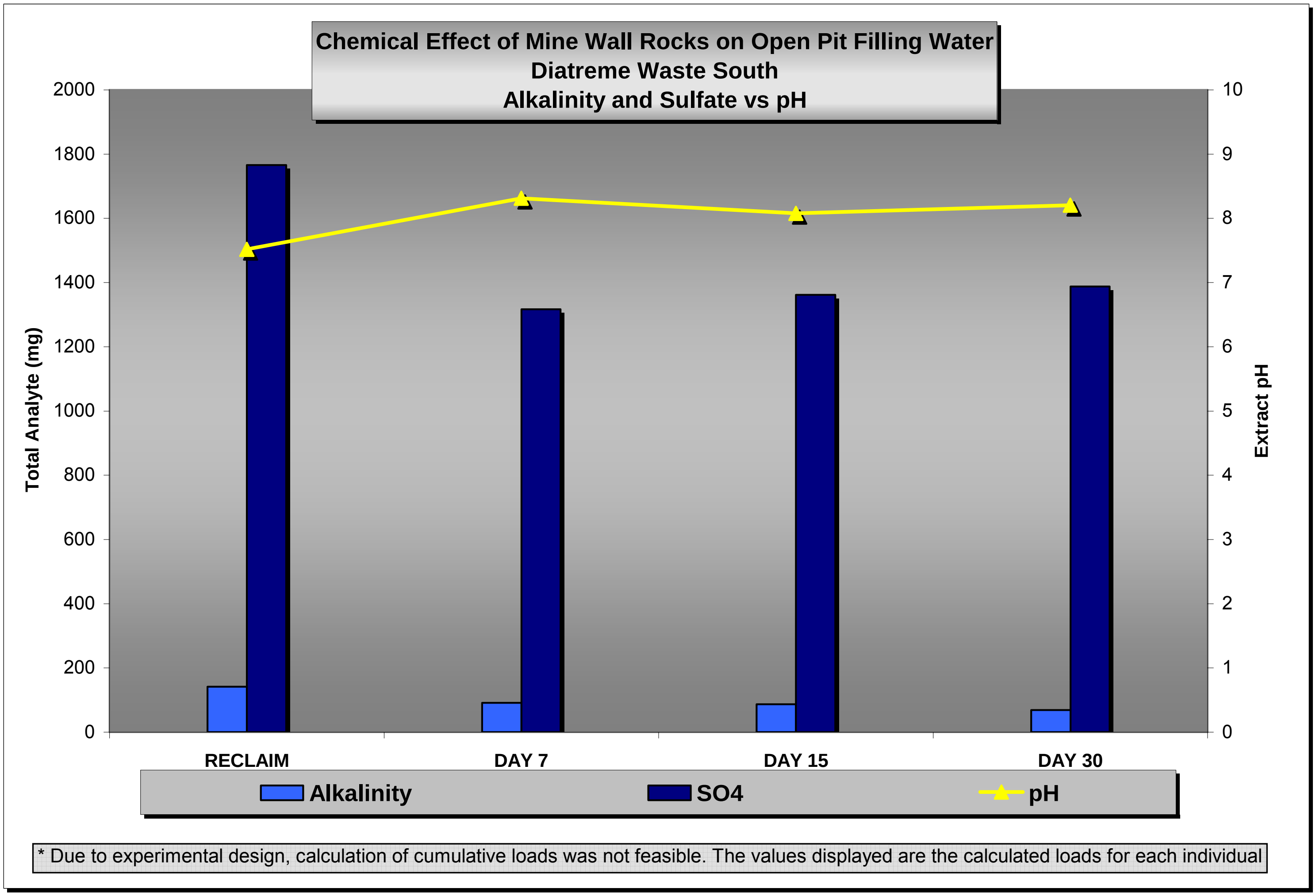


Figure C20. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

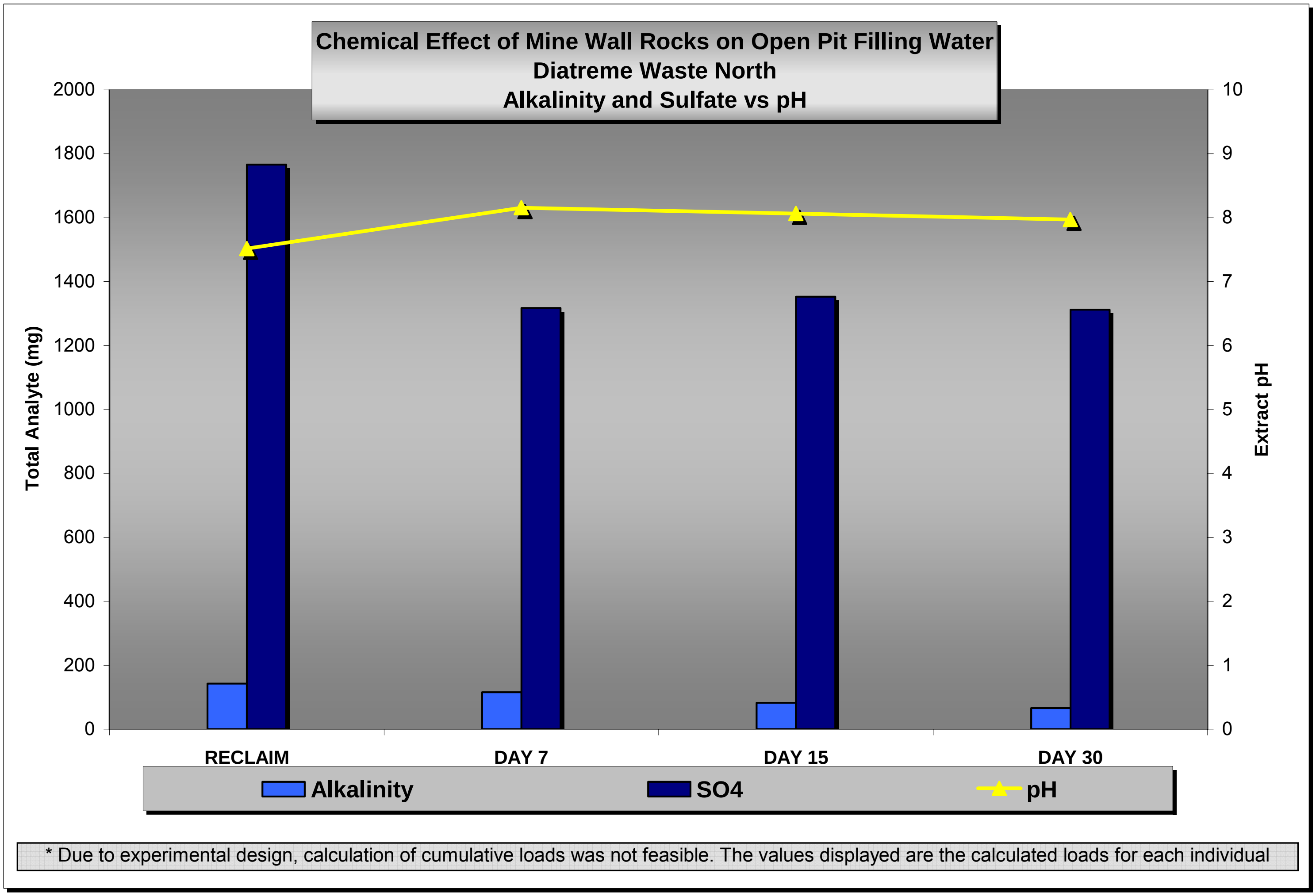


Figure C21. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

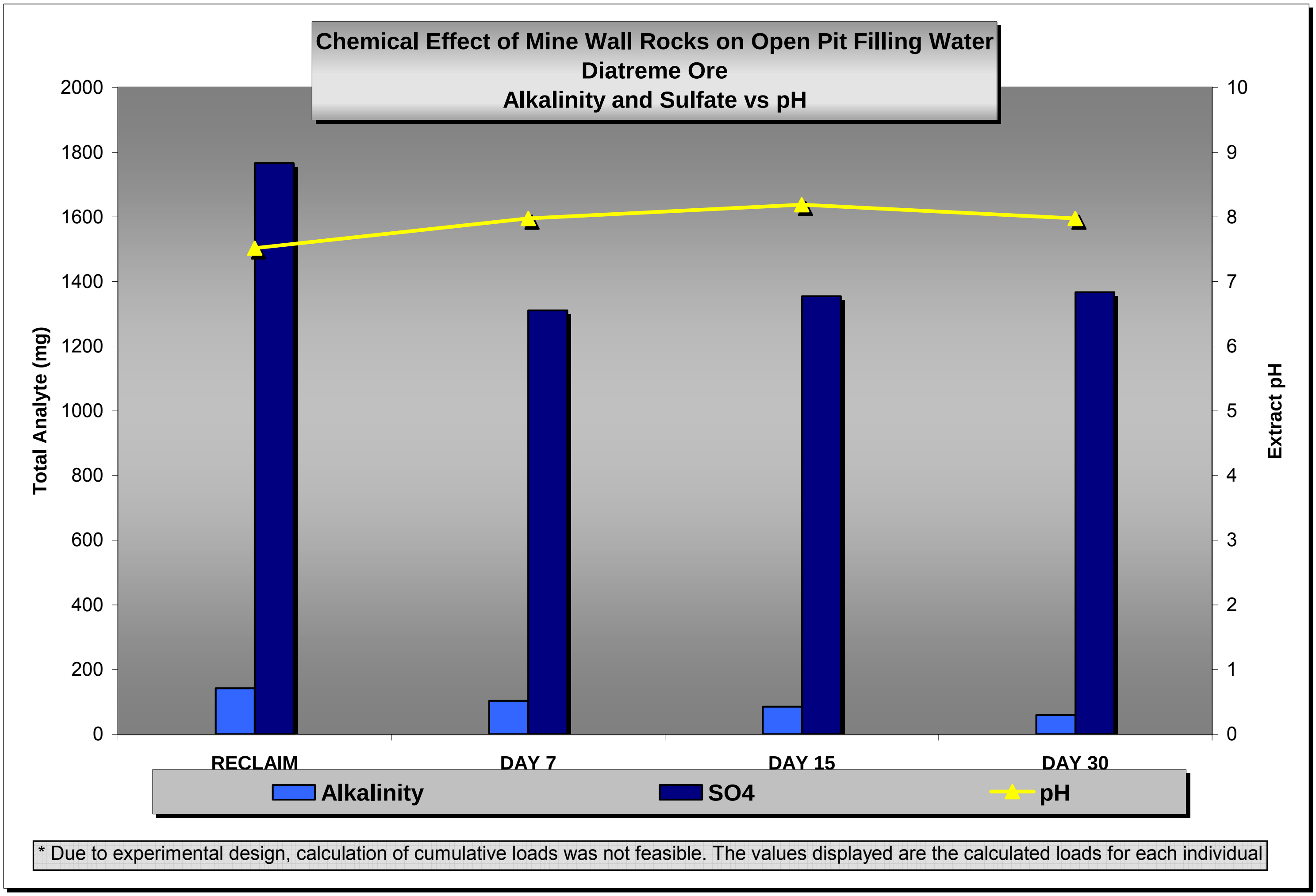


Figure C22. Pit highwall rock and pit filling water (tailings storage facility water) interaction test results.

Appendix D

Geochemistry Data for Mine Materials

TABLE D1 (Page 1 of 2)
Waste Rock Metal Mobility Data Summary - M-Pit Mine Expansion

Sample	Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Zinc
				s.u.	mg/L (Total concentrations except for samples "Column 2" and "Column 3" which are dissolved)							
Elkhorn Volcanics	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.1	1.3	0.001	<0.0001	0.005	0.02	<0.003	0.023	<0.01
			Mean	8.3	4.4	0.002	0.0001	0.011	0.03	<0.003	**0.057**	0.01
			Maximum	8.5	9.0	0.004	0.0004	**0.027**	0.05	<0.003	**0.108**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	852	0.0007	0.00006	0.0051	0.004	0.0015	0.0022	0.006
			Mean	8.0	855	0.0013	0.00010	0.0079	0.005	0.0024	**0.76**	0.006
			Maximum	8.1	858	0.002	0.00015	0.0131	0.007	0.0036	**1.93**	0.008
Lowland Creek Volcanics	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.0	4.3	0.002	<0.0001	0.001	0.01	<0.003	0.007	<0.01
			Mean	8.4	7.1	0.003	0.0001	0.006	0.02	<0.003	0.044	0.01
			Maximum	8.8	17.4	0.003	0.0002	0.012	0.04	<0.003	**0.070**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	7.9	849	0.001	0.00006	0.0072	0.002	0.0016	0.005	0.006
			Mean	7.9	870	0.002	0.00010	0.0091	0.005	0.0061	**0.96**	0.009
			Maximum	8.0	899	0.003	0.00014	0.0122	0.007	**0.011**	**2.45**	0.012
Biotite Dike	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.2	1.7	0.001	0.0001	0.003	0.01	<0.003	0.019	<0.01
			Mean	8.4	5.3	0.002	0.0002	0.013	0.02	<0.003	0.034	0.01
			Maximum	8.6	12.8	0.003	0.0004	**0.036**	0.05	<0.003	**0.085**	0.03
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.1	861	0.0004	<0.0001	0.0035	0.006	0.0012	0.003	0.007
			Mean	8.1	868	0.001	0.00005	0.0047	0.006	0.0031	**0.465**	0.008
			Maximum	8.1	872	0.002	0.00008	0.0068	0.007	0.0047	**1.37**	0.01
Quartz Latite Dike	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.0	13.0	**0.014**	0.0001	0.002	<0.01	**0.009**	0.027	<0.01
			Mean	8.2	25.7	**0.016**	0.0001	0.006	0.01	<0.003	0.037	0.01
			Maximum	8.4	60.7	**0.021**	0.0002	0.011	0.01	<0.003	0.044	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	876	**0.015**	0.00004	0.0014	0.002	<0.003	0.003	0.006
			Mean	8.0	878	**0.018**	0.00006	0.0038	0.003	0.007	**0.789**	0.008
			Maximum	8.1	881	**0.022**	0.00009	0.005	0.003	**0.011**	**2.12**	0.011
Diatreme Waste South	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	7.6	11.1	0.004	<0.0001	0.002	<0.01	<0.003	**0.104**	<0.01
			Mean	8.0	29.6	0.004	0.0001	0.006	0.01	<0.003	**0.197**	0.01
			Maximum	8.3	75.0	0.005	0.0002	0.014	0.02	<0.003	**0.323**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.1	878	0.002	0.0004	0.0026	0.002	0.004	**0.078**	0.021
			Mean	8.2	904	0.003	0.0004	0.0098	0.010	0.006	**1.012**	0.040
			Maximum	8.3	925	0.003	0.0004	**0.0224**	0.022	0.007	**2.88**	0.059
Lowest Applicable Surface Water Standard Reported in 2006 DEQ-7						0.010[1]	0.0005[2]	0.019[2]	1.0[2]	0.009[2]	0.05[3]	0.24[2]

TABLE D1 (Page 2 of 2)
Waste Rock Metal Mobility Data Summary
M-Pit Mine Expansion

Sample	Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Zinc
				s.u.	mg/L (Total concentrations except for samples "Column 2" and "Column 3" which are dissolved)							
Diatreme Waste North	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.2	9.8	0.001	<0.0001	0.003	0.01	<0.003	**0.05**	0.01
			Mean	8.3	16.6	0.002	0.0001	0.006	0.03	<0.003	**0.094**	0.01
			Maximum	8.4	34.5	0.002	0.0002	0.008	0.09	<0.003	**0.155**	0.01
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	875	0.0009	0.00007	<0.001	0.003	0.0027	0.003	0.018
			Mean	8.1	885	0.0011	0.00011	0.0026	0.008	**0.0097**	**1.39**	0.021
			Maximum	8.2	902	0.0016	0.00014	0.0048	0.017	0.0187	**2.69**	0.025
Diatreme Waste Dump 6	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	8.1	13.5	0.001	0.0001	0.004	<0.01	<0.003	**0.08**	0.01
			Mean	8.2	36.4	0.002	0.0001	0.007	0.02	<0.003	**0.247**	0.02
			Maximum	8.3	105	0.002	0.0002	0.014	0.07	<0.003	**0.477**	0.02
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	796	0.002	0.00006	0.0021	0.003	0.0008	0.006	0.007
			Mean	8.1	856	0.0027	0.00007	0.0048	0.003	0.0021	**0.78**	0.008
			Maximum	8.2	888	0.0039	0.00008	0.0084	0.005	0.0044	**2.0**	0.01
Column 2 (NAG Dump Perimeter)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.2	15.5	<0.001	<0.0001	<0.001	<0.005	<0.002	<0.005	<0.01
			Mean	8.0	33.6	<0.003	<0.0001	0.002	0.019	<0.003	0.006	0.01
			Maximum	8.4	42.7	<0.003	<0.0001	0.002	0.03	<0.003	0.009	0.01
Column 3 (5630-27 Shot)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.3	56.4	<0.001	<0.0001	<0.001	<0.01	<0.002	<0.005	<0.01
			Mean	7.8	94.7	<0.003	<0.0001	0.002	0.016	<0.003	0.014	0.01
			Maximum	8.1	125	<0.003	<0.0001	0.002	0.03	<0.003	0.026	0.01
Lowest Applicable Surface Water Standard Reported in 2006 DEQ-7						0.010 (1)	0.0005 (2)	0.019 (2)	1.0 (2)	0.009 (2)	0.05 (3)	0.24 (2)

Bold Indicates value exceeds DEQ-7 standard. In cases where total concentrations were not available, dissolved concentrations were evaluated instead.
(1) Surface Water Quality Standard for Human Health.
(2) Chronic Aquatic Water Quality Standard at 230 mg/L hardness.
(3) Secondary Maximum Contamination Level, issued for aesthetic purposes.
s.u. Standard Units

TABLE D2
Ore Metal Mobility Data Summary
M-Pit Mine Expansion

Rock Type	Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Zinc
				s.u.	mg/L (Total concentrations except for column study samples which are dissolved)							
Diatreme Ore	16 Hour Bottle Roll	6 Extracts (1 for lead)	Minimum	7.8	7.1	<0.003	0.0001	0.004	0.01	<0.003	**0.282**	0.01
			Mean	7.8	22.3	<0.003	0.0001	0.006	0.01	<0.003	**0.450**	0.01
			Maximum	7.9	43.7	0.001	0.0001	0.007	0.02	<0.003	**0.611**	0.02
	7, 15, and 30-Day soak with tailings reclaim water	3 Extracts (1 per soaking period)	Minimum	8.0	874	<0.003	0.0013	0.0004	0.002	**0.036**	0.014	0.231
			Mean	8.0	896	0.0007	0.0023	0.0039	0.011	**0.045**	**2.66**	**0.342**
			Maximum	8.2	911	0.0013	0.0032	0.0074	0.021	**0.055**	**5.29**	**0.542**
Column 1 (5470 Bench)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.5	90.9	<0.001	<0.0001	0.001	<0.005	<0.002	<0.005	0.02
			Mean	7.7	164	<0.003	0.0002	0.002	0.015	<0.003	0.009	0.03
			Maximum	8.0	259	<0.003	0.0002	0.003	0.030	<0.003	0.022	0.04
Column 4 (5390 Bench)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.3	57	<0.001	<0.0001	<0.001	0.006	<0.002	0.006	<0.01
			Mean	7.7	144	<0.003	0.0001	0.002	0.009	0.004	**0.059**	0.01
			Maximum	8.2	190	<0.003	0.0001	0.003	0.01	0.007	**0.196**	0.01
Column 5 (5690-5 Shot)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.0	52.5	<0.001	0.0001	<0.001	<0.01	<0.003	0.007	0.02
			Mean	7.4	108	<0.003	0.00027	0.002	0.011	0.003	0.046	0.03
			Maximum	7.7	151	<0.003	0.0004	0.003	0.016	0.004	**0.15**	0.04
Column 6 (Stock Pile)	Long-Term In-House Column Study	5 Leachate Samples	Minimum	7.0	121	<0.001	0.0002	0.002	0.007	<0.002	<0.005	0.02
			Mean	7.6	150	<0.003	0.00033	0.005	0.009	<0.003	0.006	0.03
			Maximum	7.9	184	<0.003	0.0004	0.01	<0.01	<0.003	0.012	0.04
Lowest Applicable Surface Water Standard Reported in 2006 DEQ-7						0.010(1)	0.0005(2)	0.019(2)	1.0(2)	0.009(2)	0.05(3)	0.24(2)

Bold Indicates value exceeds DEQ-7 standard. In cases where total concentrations were not available, dissolved concentrations were evaluated instead.
(1) Surface Water Quality Standard for Human Health.
(2) Chronic Aquatic Water Quality Standard at 230 mg/L hardness.
(3) Secondary Maximum Contamination Level, issued for aesthetic purposes.
s.u. Standard units

TABLE D-3
Tailings Metal Mobility Data Summary
M-Pit Mine Expansion

Data Source	Number of Samples	Statistic	pH	Sulfate	Arsenic		Cadmium		Copper		Iron		Lead		Manganese		Zinc		Cyanide	
					Total	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**WAD**
			s.u.	**mg/L [1]**																
TSF Pond Water Quality Samples (9-22-93 through 4-10-99)	9	Min.	6.18	291	<0.003	<0.003	0.0004	<0.0001	0.011	0.005	0.08	<0.01	0.013	<0.003	**0.298**	**0.198**	0.01	0.1	0.012	<0.0025
		Mean	7.78	635	<0.003	<0.003	**0.0005**	**0.0101**	**0.1025**	0.0339	0.1250	0.0421	**0.0170**	0.0068	**0.8790**	**1.0133**	0.0467	0.161	**0.021**	0.012
		Max.	8.69	866	<0.003	<0.003	**0.0005**	**0.02**	**0.194**	0.1	0.17	0.17	**0.021**	0.01	**1.46**	**2.84**	0.01	0.9	**0.048**	**0.031**
TSF Underdrain Water Quality Samples (2-8-94 through 4-10-99)	Not Report-ed	Min.	Data Not Available																	
		Mean	7.20	590	0.009	0.009	0.001	0.0010	**0.030**	0.030	0.80	0.80	**0.009**	0.009	**10.00**	**10.00**	0.04	0.04	**0.399**	0.025
		Max.	Data Not Available																	
TSF Embankment Drain Water Quality Samples (2-8-94 through 4-10-99)	Not Report-ed	Min.	Data Not Available																	
		Mean	7.31	774	0.002	0.002	0.005	**0.006**	**0.030**	0.034	0.12	0.04	0.008	0.009	**0.55**	**0.61**	**0.32**	0.31	**0.008**	NM
		Max.	Data Not Available																	
TSF Pond Water Quality Samples (8-16-2000 through 8-12-2004)	6 (4 for cyan-ide)	Min.	7.18	376	NA	<0.003	NA	<0.0001	NA	0.002	NA	<0.01	NA	<0.003	NA	**0.559**	NA	<0.01	<0.005	<0.005
		Mean	7.54	585	NA	0.001	NA	0.0004	NA	0.008	NA	0.02	NA	0.004	NA	**1.843**	NA	0.03	**0.016**	0.013
		Max.	7.96	883	NA	0.001	NA	0.0008	NA	0.025	NA	0.08	NA	0.007	NA	**5.51**	NA	0.08	**0.038**	0.028
Combined TSF Drains Water Quality Samples (6-25-02 through 3-3-05)	6 (3 for cyan-ide)	Min.	6.60	565	NA	<0.003	NA	<0.0001	NA	<0.001	NA	**1.07**	NA	<0.003	NA	**3.911**	NA	0.13	**0.024**	<0.005
		Mean	7.09	623	NA	0.005	NA	0.0004	NA	0.005	NA	**1.72**	NA	0.002	NA	**4.495**	NA	0.17	**0.031**	<0.005
		Max.	8.15	670	NA	0.006	NA	0.0006	NA	0.018	NA	**2.62**	NA	0.002	NA	**4.88**	NA	0.18	**0.042**	0.007
Tailings Sands Backfill Pore Water (Column leach extraction with pit dewatering water)	4 Ex-tracts	Min.	7.71	128	NA	0.005	NA	<0.0001	NA	0.003	NA	<0.01	NA	0.012	NA	**0.258**	NA	0.02	NA	NA
		Mean	7.87	143	NA	0.013	NA	0.0002	NA	0.017	NA	0.04	NA	**0.033**	NA	**0.462**	NA	0.06	NA	NA
		Max.	8.08	160	NA	**0.024**	NA	0.0003	NA	0.027	NA	0.1	NA	**0.044**	NA	**0.619**	NA	0.08	NA	NA

TABLE D-3 Tailings Metal Mobility Data Summary M-Pit Mine Expansion																				
Data Source	**Number of Samples**	**Statistic**	**pH**	**Sulfate**	**Arsenic**		**Cadmium**		**Copper**		**Iron**		**Lead**		**Manganese**		**Zinc**		**Cyanide**	
					Total	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**Dis.**	**Total**	**WAD**
			s.u.	**mg/L [1]**																
Lowest Applicable DEQ-7 Surface Water Quality Standard					0.010[2]	0.010[3]	0.0005[4]	0.005[3]	0.019[4]	1.3[3]	1.0[4]	0.30[5]	0.009[4]	0.015[3]	0.05[4]	0.050[5]	0.24[4]	2.0[3]	0.0052[4]	--

Bold Indicates value exceeds DEQ-7 standard. In cases where total concentrations were not available, dissolved concentrations were evaluated instead.
(1) Reported concentrations are either total or dissolved, as noted
(2) DEQ-7 surface water quality standard for human health.
(3) Groundwater standard.
(4) Chronic aquatic water quality standard. Based on 230 mg/L hardness (long term average for Spring Creek) where applicable.
(5) Secondary standard
s.u. Standard units

Table D4 Comparison of acid base account results for split samples of Montana Tunnels waste rock.				
Laboratory	**Sulfur**	**Neutralization Potential**	**Acid Potential**	**Net Neutralization Potential**
	%	**Tons/1000 tons as $CaCO_3$**		
Montana Tunnels	1.53	14.5	47.8	-33.3
Bondar Clegg	1.53	29.5	47.8	-18.3
Chemex labs	1.65	13.0	51.6	-38.6
Energy Labs	1.58	23.0	49.4	-26.4
Hazen Research	1.48	32.3	46.3	-14.0
Lakefield Research	1.59	38.0	49.7	-11.7
Silver Valley Labs	1.59	24.7	49.7	-25.0

TABLE D5
Open Pit Characterization Data Summary
M-Pit Mine Expansion EIS

Parameter (metals dissolved)	Pit Sump Avg 1986-2004	Dewatering Wells 1999 Average				16-Hour Bottle Roll Test Average					
		North-West	South-West	East	North Ramp	Diatreme Ore	Diatreme Waste	Lowland Creek Volcanics	Quartz Latite Dike	Biotite Dike	Elkhorn Volanics
Pit highwall Surface (percent)	NA	NA	NA	NA	NA	19.6	45.4	12.6	5.8	5.9	9.5
	Total concentrations in mg/l pH in standard units										
pH	7.7	7.98	7.42	8.06	7.36	7.8	8.2	8.4	8.2	8.4	8.3
Alkalinity (as $CaCO_3$)	200.6	174	220	135.0	280.5	41.2	63.7	41.3	84.8	61.4	47.7
Hardness (as $CaCO_3$)	347.5	274.4	280.2	156.2	571.8	42.8	76.1	191	79.3	47.9	42.4
Sodium	14.9	--	--	--	--	1.7	2.6	6.9	8.0	5.9	2.8
Potassium	4.3	--	--	--	--	19.4	18.4	3.5	8.9	5.9	6.7
Calcium	95.1	69.6	73.9	48.6	165.8	12.9	20.0	12.8	20.5	13.9	14.6
Magnesium	27.3	24.6	23.4	8.6	38.7	2.6	6.5	0.4	6.9	3.3	1.5
Sulfate	174	132.3	82.5	105.0	326.2	22.2	27.5	7.1	25.7	5.3	4.4
Chloride	3.9	1.4	1.5	4.1	9.4	<1.0	0.7	<1.0	<1.0	<1.0	<1.0
Nitrate+Nitrite	0.28	0.01	<0.01	0.01	<0.01	0.6	0.75	0.54	0.41	0.11	0.53
Arsenic	0.001	0.007	0.008	<0.003	<0.003	<0.003	<0.003	<0.003	0.016	<0.003	<0.003
Cadmium	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0001
Copper	<0.001	<0.001	0.002	0.003	0.004	0.006	0.006	0.006	0.006	0.013	0.011
Iron	0.096	0.51	0.09	0.13	0.23	0.01	0.02	0.02	0.02	0.02	0.03
Lead	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Manganese	0.211	0.089	0.049	0.010	0.293	0.500	0.179	0.04	0.036	0.034	0.057
Zinc	0.17	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01	0.01	<0.01

APPENDIX C: PLANT SPECIES - COMMON AND SCIENTIFIC NAMES

APPENDIX C
PLANT SPECIES
COMMON AND SCIENTIFIC NAMES

Common Name	Scientific Name
Baltic rush	*Juncus balticus*
Beaked sedge	*Carex rostrata*
Bebb's willow	*Salix bebbiana*
Bluebunch wheatgrass	*Agropyron spicatum*
Bluejoint reedgrass	*Calamagrostis canadensis*
Booth willow	*Salix boothii*
Canada thistle	*Cirsium arvense*
Common horsetail	*Equisetum arvense*
Common yarrow	*Achillea millefolium*
Dalmatian toadflax	*Linaria dalmatica*
Douglas-fir	*Pseudotsuga menziesii*
Drummond willow	*Salix drummondiana*
Engelmann spruce	*Picea engelmannii*
Houndstongue	*Cynoglossum officinale*
Idaho fescue	*Festuca idahoensis*
Kentucky bluegrass	*Poa pratensis*
Lodgepole pine	*Pinus contorta*
Musk-root	*Adoxa moschatellina*
Nebraska sedge	*Carex nebraskensis*
Peculiar moonwort	*Botrychium paradoxum*
Pinegrass	*Calamagrostis rubescens*
Quaking aspen	*Populus tremuloides*
Red raspberry	*Rubus idaeus*
Redtop	*Agrostis stolonifera*
Rough fescue	*Festuca scabrella*
Smooth bromegrass	*Bromus carinatus*
Snowberry	*Symphoricarpos albus*
Spotted knapweed	*Centaurea maculosa*
Thinleaf alder	*Alnus incana*
Timothy	*Phleum pratense*
Yellow toadflax	*Linaria vulgaris*

APPENDIX D: TESTING AND CHARACTERIZATION PLAN

APPENDIX D

Proposed Waste Rock Monitoring Plan for Montana Tunnels

November 27, 2007

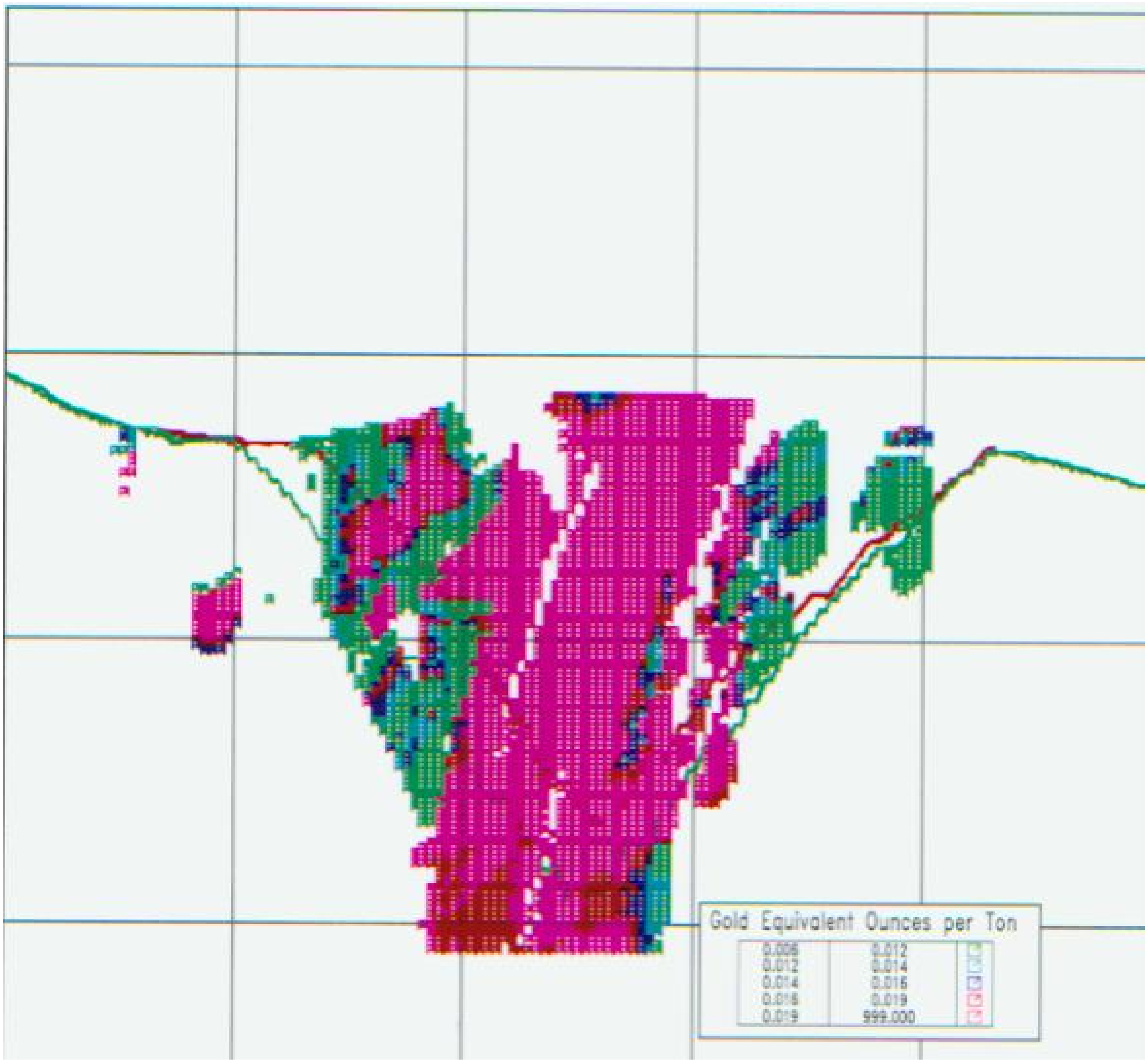
The draft EIS calls for operational analysis of waste rock in the course of mining. The following is a suggested test program that would make use of the existing MTMI blast hole sampling program to gather data on waste rock geochemistry over the course of mining the L and M-Pits. It would make more data available from the company's own analyses of rock for Au, Ag, Pb, Zn, plus composite S and ABA for drill and blast patterns. These samples would provide representative material for the requested kinetic and metal mobility tests.

- All data collected from each blast pattern in the ore and waste control program for metals, total sulfur, and acid-base accounting, along with geographic coordinates of each blast pattern, would be reported annually to the agencies by the company in tables, map and graph form. The data would be used to develop and update an empirical relationship between L-Pit monitored parameters and kinetic tests results that can be used to evaluate M-Pit waste rock. In particular, these data will be used to determine whether the relationship between Pb and Zn concentrations and total sulfur content will continue to be reliable in identifying potentially reactive waste rock during production of the M-Pit.

<u>Description of Montana Tunnels Ore Body and Open Pit Mine</u>

The Montana Tunnels ore deposit is located in the vertical vent of a Maar type volcano. The principal rock that fills the volcanic pipe is a diatreme breccia containing a rich matrix of volcanic wall rock and intrusive rock fragments from gaseous explosions associated with the formative volcanic phases. Overall, the diatreme contains widely disseminated sulfide mineralization but the economic ore grade material (which is sulfide enriched) is located more centrally in the volcanic pipe around the late stage emplacement of intrusive quartz latite porphyry dikes. The upper level of this core ore body was mined from a starting elevation at 5850 feet down to 4800 feet during first 16 years of operations. Additional development drilling has revealed that the core ore body extends at depth beneath the original pit designs to elevations below 3800 feet. To reach the core ore at lower elevations, the upper area of the mine must be increasingly widened to maintain stable pit highwalls as mining advances to the deeper core ore deposit. The resulting upper wall rock is all sparsely mineralized diatreme and volcanic rock that is mined to reach the centrally located ore at lower elevations and disposed as waste rock.

The following section diagram shows a mineralized block model of the Montana Tunnels ore body based on gold equivalent grade of all contained economic precious and base metals. The section is looking north with Clancy Creek on the left of the upper pit area. The magenta, red and blue colored blocks represent high to low-grade ores with green representing sub-grade diatreme. The outlying white area is sparse to non-mineralized diatreme and country rock. Early pit highwall outlines are illustrated on the diagram showing the existing upper level laybacks extending into non-mineralized zones.


Gold Equivalent Ounces per Ton
0.006 0.012
0.012 0.014
0.014 0.016
0.016 0.019
0.019 999.000

The illustration below, A3-1, is a plan view of the Montana Tunnels open pit mine in the year 2000. A comprehensive sampling program was conducted to obtain geochemical characterization of the wall surface rocks at selected pit highwall elevation intervals and quadrants. Sampling locations are shown on the drawing. The respective lithologies of the pit highwalls are illustrated by color. Volcanics, intrusives and different grades of mineralized diatreme are depicted with the core ore diatreme shown in the central area of the open pit. Composites of deep drilling sample intervals up to 700 feet below the pit bottom elevation are also included in geochemical characterization data. The plan drawing shows the upper walls of the open pit laying back into surrounding non-mineralized rock. Samples are identified by lithology with geochemical characterization by depth showing that base metals, sulfide mineralization and net neutralizing potentials change as the sampling converges into the core ore area of the cone shaped pit. Samples for this monitoring program were collected from upper pit highwall rocks up to an elevation at 6100 feet to drilling intervals down to 4000 feet elevation. Data tables A, B and C following the diagram are arranged by sample elevation to illustrate changes in geochemical characteristics as a result of the conical geometry of the open pit mine and the column shaped core ore body. Table A provides lithology identification for composite rock samples taken from each location plus alkali and alkaline earth metal concentrations. Table B provides whole rock total metals analysis. Table C provides acid-base characterization for each sample including neutralizing potential, total sulfur content and net neutralizing potential. The results from this detailed sampling program can be used to compare with data from future pit sample characterization as the upper mine walls are laid further back from the core ore area and as the core ore area at the bottom of the open pit is mined.

A final drawing labeled Pit Profiles Looking South is a section drawing that depicts the wall layback between L-Pit and M-Pit that will be mined to reach the deeper core ore area. Elevations are provided to show the depth of the core area and the overlying core area that has been mined out during the life of operations.

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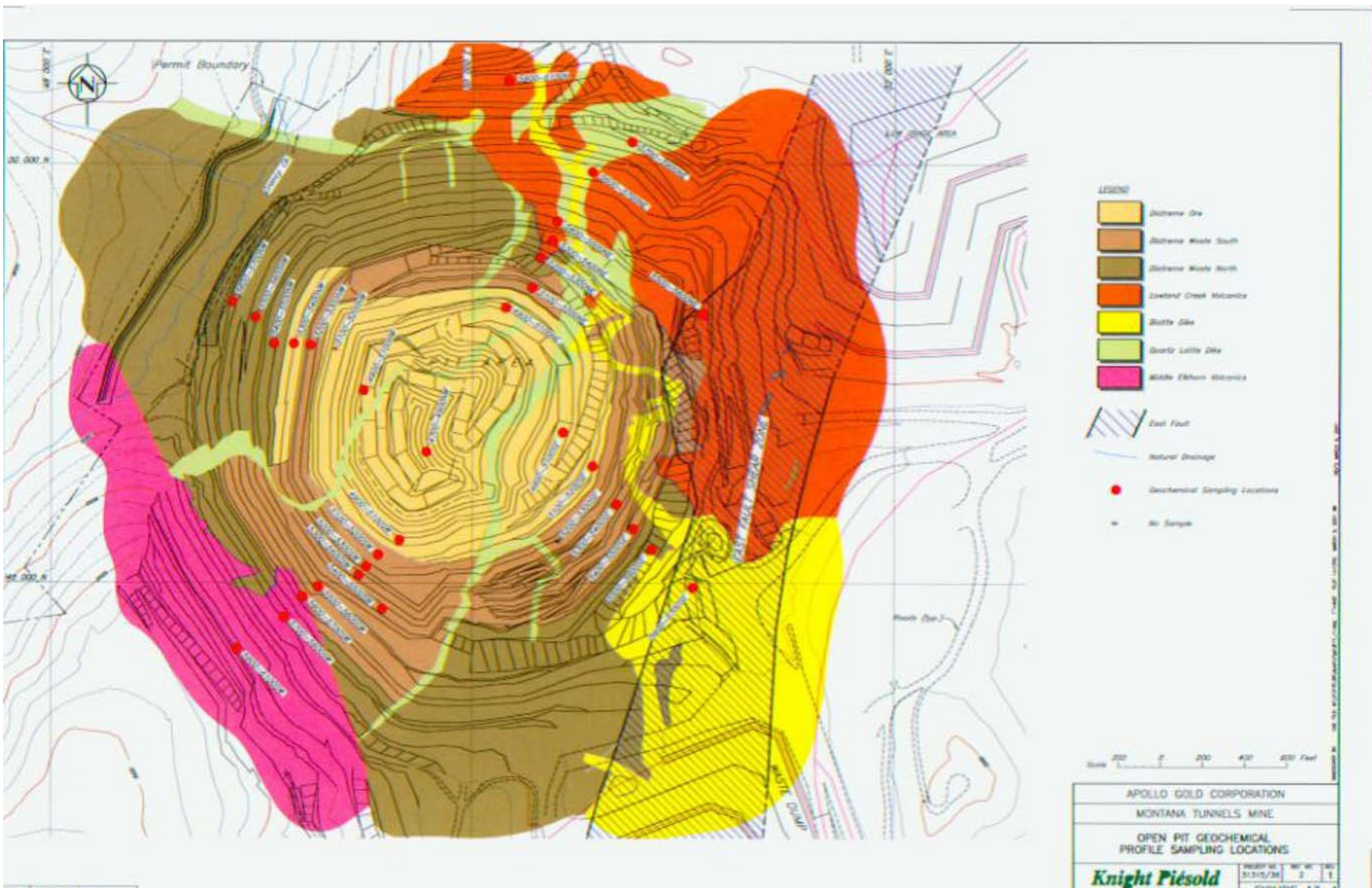


TABLE A: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Rock Identification		General Metals Analysis			
		Ca	Mg	Na	K
Sample ID	Rock Type	mg/kg	Mg/kg	mg/kg	mg/kg
5900-6100 N	Lowland Creek Volcanics	18200	5159	26060	23460
5900-6100 SW	Elkhorn Volcanics	7210	16040	5525	29640
5700-5900 NE	Lowland Creek Volcanics	11140	9765	20190	26330
5700-5900 SW	Elkhorn Volcanics	16840	16210	7967	29160
5600-5700 NW	Lowland Creek Volcanics	14840	4177	9917	37090
5600-5700 NE	Lowland Creek Volcanics + Biotite Dike	8903	7526	5939	46050
5600-5700 SE	Lowland Creek Volcanics + Biotite Dike	8523	3852	13130	39730
5600-5700 SW	Elkhorn Volcanics + Diatreme Breccia	13080	10810	7396	37960
5500-5600 NW	Lowland Creek Volcanics + Diatreme Breccia	14640	5814	19010	25550
5500-5600 NE	Lowland Creek Volcanics + Diatreme Breccia	15910	6738	20590	24050
5500-5600 SE	Lowland Creek Volcanics + Diatreme Breccia	11490	6249	16790	27880
5500-5600 SW	Diatreme Breccia	7248	6050	3806	41280
5400-5500 NW	Diatreme Breccia	15510	3298	8320	36960
5400-5500 NE	Diatreme Breccia	18290	5121	23320	25790
5400-5500 SE	Diatreme Breccia	13260	4552	8933	41520
5400-5500 SW	Diatreme Breccia	9535	3047	1254	47470
5300-5400 NW	Diatreme Breccia	5829	2721	842	40870
5300-5400 NE	Diatreme Breccia	12640	4773	9933	35400
5300-5400 SE	Diatreme Breccia	12570	3477	9333	39940
5300-5400 SW	Diatreme Breccia	14480	3626	3002	42360
5200-5300 NW	Diatreme Breccia	8690	3078	727	41470
5200-5300 NE	Diatreme Breccia	13620	5406	15000	32230
5200-5300 SE	No Sample				

TABLE A: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Rock Identification		General Metals Analysis			
		Ca	Mg	Na	K
Sample ID	Rock Type	mg/kg	Mg/kg	mg/kg	mg/kg
5200-5300 SW	Diatreme Breccia + Quartz Latite Dike	14230	4414	4092	38180
5100-5200 NW	Analysis Not Completed				
5100-5200 NE	Diatreme Breccia	10790	5198	10240	38550
5100-5200 SE	Diatreme Breccia	10840	4308	5602	43670
5100-5200 SW	Analysis Not Completed				
4900-5100 NW	Diatreme Breccia	2547	3346	1312	37030
4900-5100 NE	Diatreme Breccia	5697	4100	2348	48770
4900-5100 SE	Diatreme Breccia	8299	4366	6544	36090
4900-5100 SW	Diatreme Breccia	4188	3056	1289	50780
4700-4900 Ore	Diatreme Breccia	2085	3002	495	35540
4500-4700 HG (Drill Comp)	Diatreme Breccia	8037	2816	1104	48750
4500-4700 LG (Drill Comp)	Diatreme Breccia	6586	2628	1163	49860
4300-4500 HG (Drill Comp)	Diatreme Breccia	1817	3884	531	30490
4300-4500 LG (Drill Comp)	Diatreme Breccia + Quartz Latite Dike	12910	7501	6519	31450
4000-4300 HG (Drill Comp)	Diatreme Breccia	13410	3827	342	33390
4000-4300 LG (Drill Comp)	Diatreme Breccia	19770	3985	408	32620

TABLE B: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Geochemical Analysis - Metals

Sample ID	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cu mg/kg	Fe mg/kg	Pb mg/kg	Mn mg/kg	Ni mg/kg	Se mg/kg	Zn mg/kg
5900-6100 N	0.3	80000	3.1	502	0.6	37.2	14600	31	299	0.0	0.0	91
5900-6100 SW	1.7	73500	42.9	538	0.5	89.8	61500	79	1440	0.0	0.0	237
5700-5900 NE	0.3	74000	16.5	434	0.3	23.1	41550	27	448	8.9	0.0	116
5700-5900 SW	1.7	64500	21.1	513	0.1	52.6	53500	32	2530	0.0	0.0	142
5600-5700 NW	4.8	71500	11.7	834	0.2	28.7	19250	179	4210	0.0	0.0	111
5600-5700 NE	4.1	81500	10.4	978	0.2	87.4	22000	44	2480	0.0	0.0	142
5600-5700 SE	2.8	75500	39.3	525	0.2	10.6	15400	216	2120	0.0	0.0	225
5600-5700 SW	3.8	75500	38.7	1010	0.4	40.8	41250	115	2310	0.0	0.0	243
5500-5600 NW	0.3	29450	15.2	449	0.1	0.0	11000	46	123	4.6	0.0	71
5500-5600 NE	0.3	66500	21.6	478	0.1	5.1	16750	35	658	5.1	0.0	89
5500-5600 SE	0.7	87500	15.4	1220	0.0	11.9	14850	27	686	6.7	0.0	98
5500-5600 SW	5.9	74000	46.0	872	1.5	38.6	24050	537	4620	5.6	0.0	768
5400-5500 NW	7.2	82500	11.6	1040	0.5	37.2	17850	196	2685	2.3	0.0	301
5400-5500 NE	0.3	59500	14.3	727	0.1	0.0	15650	75	332	0.0	0.0	122
5400-5500 SE	4.8	75000	30.9	932	1.9	62.7	73500	751	4110	0.0	0.0	972
5400-5500 SW	6.2	72500	21.9	834	3.1	20.0	15900	352	5720	0.0	0.0	1110
5300-5400 NW	6.2	76000	41.9	954	13.2	173.0	19800	2170	3690	0.0	0.0	4775
5300-5400 NE	1.7	69000	24.8	803	2.3	38.4	16100	557	3290	0.0	0.0	948
5300-5400 SE	8.6	67500	51.6	537	3.0	45.2	26300	534	3830	0.0	0.0	1360
5300-5400 SW	12.8	64000	19.6	765	1.4	41.9	13600	467	4510	7.5	0.0	712
5200-5300 NW	6.6	70000	37.0	772	2.9	44.5	18900	882	7500	8.3	0.0	1240
5200-5300 NE	2.1	65000	14.1	713	1.3	22.6	24500	309	1610	3.8	0.0	566
5200-5300 SE	No Sample											

TABLE B: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Geochemical Analysis - Metals

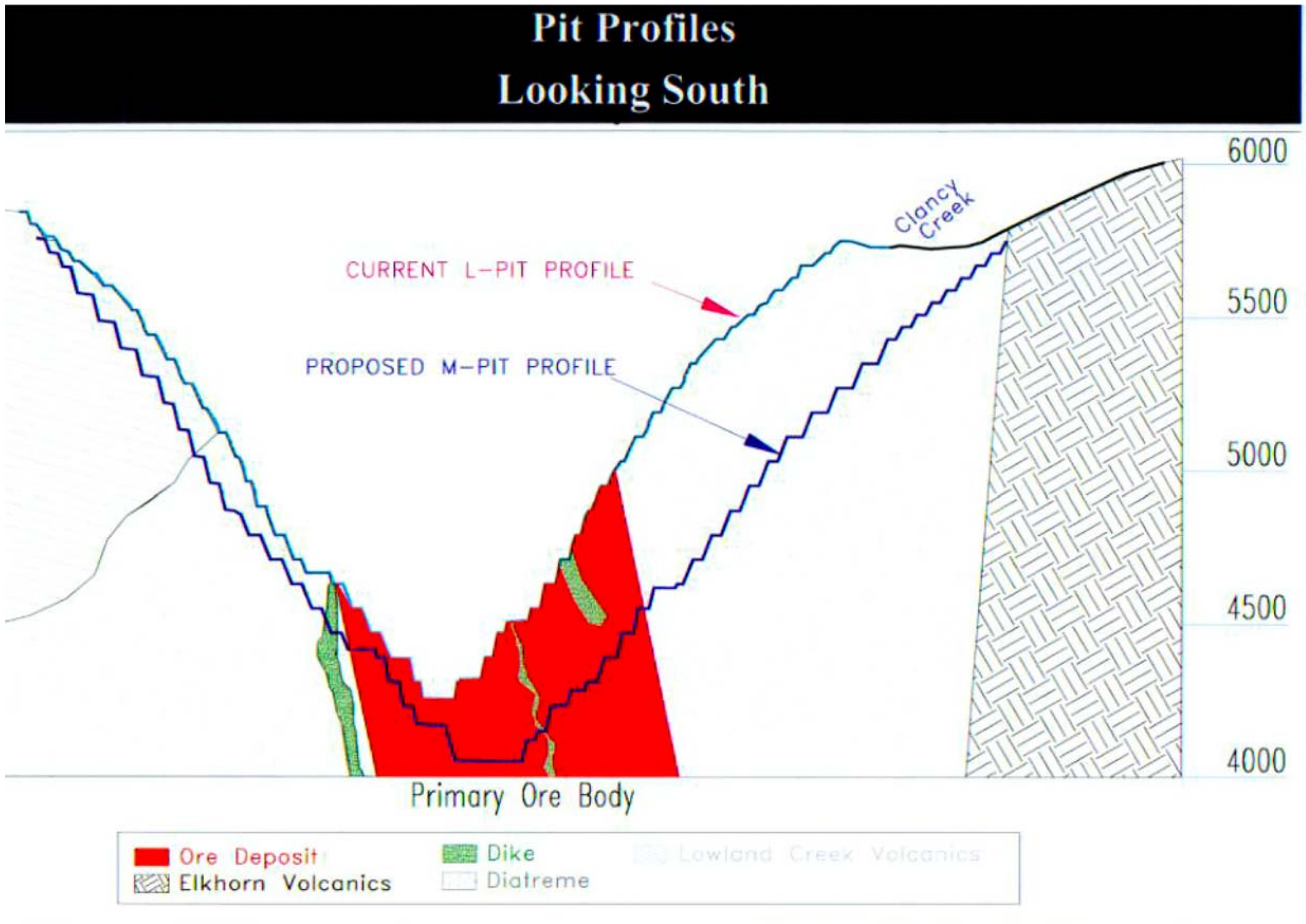
Sample ID	Ag mg/kg	Al mg/kg	As mg/kg	Ba mg/kg	Cd mg/kg	Cu mg/kg	Fe mg/kg	Pb mg/kg	Mn mg/kg	Ni mg/kg	Se mg/kg	Zn mg/kg
5200-5300 SW	3.4	74500	25.9	880	3.5	35.9	25900	807	4570	5.7	0.0	1470
5100-5200 NW	No Analysis											
5100-5200 NE	1.4	70500	27.5	727	2.4	30.6	28200	481	2790	0.5	0.0	1030
5100-5200 SE	3.4	70000	39.8	565	4.4	45.9	25200	823	4360	18.3	0.0	1710
5100-5200 SW	No Analysis											
4900-5100 NW	6.9	85500	32.8	741	19.1	219.0	51000	744	5100	0.0	0.0	5980
4900-5100 NE	2.1	86000	15.4	895	5.9	41.7	24800	1410	4215	16.8	0.0	6700
4900-5100 SE	5.2	68500	29.9	414	12.8	121.0	31950	1320	3210	17.8	0.0	4445
4900-5100 SW	3.1	74500	22.8	1140	5.3	116.0	28000	1390	3510	23.5	0.0	2110
4700-4900 Ore	7.2	65500	25.3	726	24.9	189.0	33300	3060	4100	0.0	0.0	8950
4500-4700 HG	3.1	68000	12.8	591	13.4	110.0	23600	1580	5700	18.7	0.0	5800
4500-4700 LG	2.1	70000	12.3	784	6.2	33.3	17850	1771	3670	102.0	0.0	2590
4300-4500 HG	4.5	73000	12.9	463	18.5	158.0	39650	903	3360	84.7	0.0	6700
4300-4500 LG	6.2	61500	8.3	541	3.4	232.0	27400	277	1090	106.0	0.0	1310
4000-4300 HG	13.8	70000	16.7	746	13.2	469.0	28950	1400	3720	108.0	0.0	5050
4000-4300 LG	1.7	63000	13.2	151	2.2	26.1	19100	359	2810	64.6	0.0	849

TABLE C: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Sample ID	Lime Content	Neut. Potential	Sulfur	Acid Potential	Net Neut. Potential
	% CaCO3	ppt CaCO3	%S	ppt CaCO3	ppt CaCO3
5900-6100 N	2.02	20.2	0.02	-0.6	19.6
5900-6100 SW	1.28	12.8	0.04	-1.3	11.5
5700-5900 NE	1.57	15.7	0.01	-0.3	15.4
5700-5900 SW	2.80	28.0	0.15	-4.7	23.3
5600-5700 NW	4.16	41.6	0.44	-13.7	27.9
5600-5700 NE	1.56	15.6	0.34	-10.6	5.0
5600-5700 SE	1.51	15.1	0.22	-6.9	8.2
5600-5700 SW	2.29	22.9	0.48	-15.0	7.9
5500-5600 NW	3.64	36.4	0.30	-9.4	27.0
5500-5600 NE	4.38	43.8	0.39	-12.2	31.6
5500-5600 SE	2.88	28.8	0.22	-6.9	21.9
5500-5600 SW	2.28	22.8	0.70	-21.8	1.0
5400-5500 NW	4.31	43.1	0.30	-9.4	33.7
5400-5500 NE	4.07	40.7	0.41	-12.8	27.9
5400-5500 SE	3.21	32.1	0.68	-21.2	10.9
5400-5500 SW	2.75	27.5	0.46	-14.4	13.1
5300-5400 NW	1.78	17.8	1.23	-38.4	-20.6
5300-5400 NE	3.84	38.4	0.62	-19.3	19.1
5300-5400 SE	3.08	30.8	0.87	-27.1	3.7
5300-5400 SW	3.86	38.6	0.38	-11.9	26.7
5200-5300 NW	2.92	29.2	0.72	-22.5	6.7
5200-5300 NE	3.01	30.1	0.32	-10.0	20.1
5200-5300 SE	No Sample				
5200-5300 SW	3.91	39.1	0.60	-18.7	20.4

TABLE C: PIT HIGHWALL GEOCHEMICAL PROFILE SAMPLING DATA

Sample ID	Lime Content % CaCO3	Neut. Potential ppt CaCO3	Sulfur %S	Acid Potential ppt CaCO3	Net Neut. Potential ppt CaCO3
5100-5200 NW	1.94	19.4	0.98	-30.6	-11.2
5100-5200 NE	2.54	25.4	0.70	-21.8	3.6
5100-5200 SE	2.96	29.6	1.07	-33.4	-3.8
5100-5200 SW	2.81	28.1	0.61	-19.1	9.0
4900-5100 NW	0.99	9.9	1.57	-49.0	-39.1
4900-5100 NE	2.48	24.8	1.01	-31.5	-6.7
4900-5100 SE	1.78	17.8	0.62	-19.3	-1.5
4900-5100 SW	1.31	13.1	1.14	-35.6	-22.5
4700-4900 Ore	1.02	10.2	1.71	-53.4	-43.2
4500-4700 HG (Drill Comp)	2.47	24.7	1.23	-38.4	-13.7
4500-4700 LG (Drill Comp)	1.95	19.5	0.85	-26.5	-7.0
4300-4500 HG (Drill Comp)	0.84	8.4	1.31	-40.9	-32.5
4300-4500 LG (Drill Comp)	4.31	43.1	1.35	-42.1	1.0
4000-4300 HG (Drill Comp)	3.54	35.4	1.60	-49.9	-14.5
4000-4300 LG (Drill Comp)	4.88	48.8	0.48	-15.0	33.8



Pit Profiles
Looking South
6000
5500
5000
4500
4000
Clancy Creek
CURRENT L-PIT PROFILE
PROPOSED M-PIT PROFILE
Primary Ore Body
Ore Deposit
Elkhorn Volcanics
Dike
Diatreme
Lowland Creek Volcanics

Operational Mined Rock and Tailings Monitoring Program:

- Eight to ten samples each (8 to 10 kg sample size) of diatreme and quartz latite dike would be collected from mine blasts from depths between 4,500 to 4,300 feet during the conclusion of L-Pit mining. The locations and lithology of the rocks where the samples are collected will be noted. These samples will represent lithologies from the core ore area of the pit and will be assayed for As, Ba, Cd, Ca, Cu, Fe, Pb, Mg, Mn, K, Na, Ni, Se, Zn, S and ABA Representative samples spanning a range of sulfide mineralized diatreme grades will be selected or composited for further testing with ASTM Method D 5744-96 humidity cell testing.

- Sets of eight to ten samples each of the given lithologies Lowland Creek Volcanics and Elkhorn Volcanics will be collected, and a composite sample for each lithology then made and submitted for kinetic and meteoric water mobility testing. These sampling locations are readily available from exposed upper pit highwall laybacks. An additional ten samples of lower mineralized diatreme pit highwall rock samples from various elevations and quadrants of the open pit highwalls will be collected to represent a full range of low to higher sulfide mineralized diatremes away from the core ore area. Following geochemical characterization of these samples, individual samples will be selected or composites will be prepared from the individual samples that represent the extended range of mineralized diatremes. It will be important to be able to relate the analysis to the Pb and Zn cutoff points for waste rock in both the L-Pit and M-Pit. The geochemical characterization analysis for each of these samples should be run in the on-site lab at Montana Tunnels. Once the range of mineralized samples has been identified, the selected samples will undergo testing according to ASTM methods. The eight to ten samples that make up the composite sample should be taken from various portions across the pit, approximately four locations in all. (It would be desirable to concentrate the sampling in blast patterns below the permitted elevation of the L-Pit. Most of the volume of rock to be mined in the proposed M-Pit lies above 4,250 ft. (See Figure 3.3-1 in the draft EIS.) Since the main concern is with the possible increase in waste rock sulfur concentrations with increasing depth, selective sampling of deeper rock would provide more useful information.)

- A lysimeter should be installed in dewatered tailings to obtain samples of pore water from the unsaturated zone. Multiple lysimeters could be used. The lysimeters could be placed in the old tailings study plot that still exists. A sample of the tailings should also be collected at that time for whole rock analysis and changes in other parameters tested when the plots were constructed.

- Eight to ten samples should be collected from the lowest elevation of the exposed pit highwalls (below 4,500 feet) for full geochemical analysis and long-term kinetic testing. Such samples could indicate the effects of prior weathering on water-rock interactions.

- The reactions between tailings water and/or open pit mine water and the various wall-rock lithologies should be tested, since drainage from the tailings impoundment would be directed toward the pit after the end of mining. This could be either by column or pan for the mineralized range of diatremes, quartz latite dike Elkhorn volcanics and Lowland Creek volcanics. Pit lake water will contain the solutes from these water sources and will be the type of water in perpetual contact with these lithologies. The results from these tests can be compared with kinetic testing that uses simulated meteoric water.

- It will be important to collect the high grade diatreme samples before L-Pit mining is completed because M-Pit will not again reach the bottom of the core ore body until the last years of the M-Pit mining plan. The final L-Pit elevation will be about 4,300 feet while the final M-Pit elevation is designed to reach about 4,050 feet elevation - only 250 feet lower. Core ore materials at the bottom of L-Pit will be representative of core ore materials at the bottom of M-Pit and will allow time for kinetic testing to be conducted during the five-year M-Pit mining plan.

- Use of alternate methodology (field weathering, etc.,) is acceptable as long as it can be replicated using standard ASTM methodologies. Test methods should represent both the solute chemistry (i.e. tailings water and incident precipitation) and oxidation conditions of the environment represented (*e.g.* pit lake vs. dewatered tailings or unsaturated waste rock).

- Also, column or pan tests of each rock should be constructed and saturated with test water from tailings or the mine with a pore water sample extracted and analyzed to evaluate any changes occurring within saturated solids where little or no water movement will occur, such as in the bulk mass of the tailings impoundment or at the bottom of the open pit lake that will be inundated with solids from pit highwall erosion and upper bench raveling.

Note:
The EIS team needs to come up with an acid generating cutoff point for the waste rock and determine what needs to be done at that time. The rock could be encapsulated at a greater depth, stored near the pit highwall and then pushed into the pit, or some other mitigation.

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